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THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY—VOL. XIV.

REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

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PREPARED UNDER THE SUPERINTENDENCE OF

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AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

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THE Editor of the Challenger Reports will be greatly obliged to Authors sending him copies of separate papers, or references to works, in which the Challenger discoveries are referred to, or the observations of the Expedition are discussed.

This will greatly facilitate the compilation of a complete Bibliography, and the discussion of the results of the Expedition, in the final Volume of the Series.

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I.—Report on the Tunicata collected during the Voyage of H.M.S. Challenger, during the years 1873–1876. Part II.—Ascidiæ Compositæ.

By William A. Herdman, D.Sc., F.L.S., F.R.S.E., Professor of Natural History in University College, Liverpool.

(*The Manuscript was received in Instalments between 7th January* 1885 *and* 18*th January* 1886.)

II.—Report on the Holothurioidea dredged by H.M.S. Challenger, during the years 1873–1876. Part II.

By Hjalmar Théel.

(*The Manuscript was received 4th June* 1885.)

EDITORIAL NOTES.

This volume contains Parts XXXVIII. and XXXIX. of the Zoological Series of Reports on the Scientific Results of the Expedition.

Part XXXVIII.—This Memoir on the Ascidiæ Compositæ forms the Second Part of Professor W. A. Herdman's Report on the Tunicata collected by the Expedition. The First Part of the Report was published in 1882, as part of Volume VI., and Part XVII. of the Zoological Series of Reports.

Professor Herdman is at present engaged in the preparation of the Third and concluding part of his Report, and it is expected to be ready for publication early in 1887.

Part XXXIX.—This Memoir forms the Second and concluding Part of Dr. Hjalmar Théel's Report on the Holothurioidea of the Expedition. The First Part was published in 1882 in Volume IV., forming Part XIII. of the Zoological Series of Reports.

The Synopsis will be of great and permanent value to all working Naturalists, and Dr. Théel is to be congratulated upon the conclusion of this extensive, thorough and painstaking contribution to science.

John Murray.

Challenger Office, 32 Queen Street,
Edinburgh, *8th May* 1886.

ERRATA IN PART XXXVIII.

Page 41. The species described as *Botrylloides purpureum* was afterwards changed to *Botrylloides tyreum* (see p. 381).

Page 238, line 14 from top of page, *for* "*Psammaplidium incrustans*" *read* "*Psammaplidium effrenatum.*"

Page 267, line 3 from foot of page, *for* "*Diplosomoides*" *read* "*Didemnoides.*"

Page 276, lines 7 and 10 from top of page, *for* "Leptoclinidæ" *read* "Didemnidæ."

ADDENDA TO PART XXXIX.

Page 24, under "*Synapta inhærens*, O. F. Müller, 1788," insert as synonyms "*Holothuria* (*Minyas ?*) *flava*, Rathke, 1843, and *Synapta flava*, Lampert, 1885."

Page 26, under "*Synapta lumbricoides*, Eschscholtz, 1829," insert "*Synapta lumbricus*, Jæger, 1833."

Page 34, under "*Chirodota australiana*, Stimpson, 1856," insert "according to Semper, 1868, possibly a new genus, *Taniogyrus.*"

Page 34, under "*Chirodota violacea*, Peters, Müller, 1849," insert "*Hab.*, Amirante Islands (Bell, 1884)."

Page 34, under "*Chirodota laevis*, Fabricius, 1780," insert "*Chirodota pellucida*, Sars, 1861."

Page 101, under "*Cucumaria lactea*, Forbes, 1841," insert "*Hab.*, West Coast of France (Barrois, 1882)."

Page 112, under "*Cucumaria longipeda*, Semper, 1868," insert "*Hab.*, Japan (v. Marenzeller, 1881)."

Page 209, under "*Holothuria grüffei*, Semper, 1868," insert "(?) *Stichopus troschelii*, J. Müller, 1854, and *Holothuria troschelii*, Müller, Lampert, 1885."

Page 240, under "*Anaus holothuroides*, Sluiter, 1880," insert "*Aproctus holothuroides*, Verloren, 1881."

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the TUNICATA collected during the Voyage of H.M.S. Challenger during the Years 1873–76. By WILLIAM A. HERDMAN, D.Sc., F.L.S., F.R.S.E., Professor of Natural History in University College, Liverpool.

PART II.—ASCIDIÆ COMPOSITÆ.

PREFACE.

THE first part of this Report, treating of the ASCIDIÆ SIMPLICES of the collection, was published in the end of 1882, and at that time it seemed probable that the remainder of the Tunicata could be described in a second and considerably smaller part which would be ready for publication some time in 1884. The Compound Ascidians, however, proved on careful examination to be a much larger and more varied group than had been anticipated. On account of the difficulty in finding good diagnostic characters, and of the similarity which different species sometimes show in their external appearance, it has been necessary to submit nearly all the specimens in the collection to a detailed histological examination, and portions of most of them have had to be sectionised—a slow and laborious proceeding—before the relations of their different parts could be satisfactorily determined. Then, in the case of a few species, some interesting peculiarities in regard to reproduction by gemmation, having an important bearing upon the mode of formation of the colony, required a careful and lengthened examination. For these

reasons the present part of the Report, though including only the Compound Ascidians, has taken longer to prepare and has reached a larger size than was expected. A description of the pelagic forms (the Pyrosomidæ, the Appendiculariidæ, and the Thaliacea), forming the third and concluding part of the Report, will probably appear during the next year.

The large collection of Ascidiæ Compositæ, which was for the most part found to be in good condition for histological examination, represents one hundred and two species and well-marked varieties, arranged in twenty-five genera. Eighty-eight of the species and ten of the genera are new to science. As no preliminary report upon the Compound Ascidians was published, these new genera and species are described here for the first time. I have found it necessary to form two new families, the Cœlocormidæ and the Polystyelidæ.

The Compound Ascidians collected during the cruises of H.M.SS. "Lightning" and "Porcupine" in the summers of 1868–70 were sent to me by Mr. Murray for examination. They have been incorporated in the Challenger collection, and the descriptions of them will be found in the Systematic Part of this Report.[1]

Since the publication of the first part of the Report, several specimens of Simple Ascidians belonging to the Challenger collection, which had previously been overlooked, have been sent to me for examination. I have placed the description of these forms as an Appendix at the conclusion of this part of the Report.

[1] The Simple Ascidians of the "Porcupine" and "Lightning" expeditions were described in a paper read in January 1884, before the Royal Society of Edinburgh, and published in its Transactions (*Trans. Roy. Soc. Edin.*, vol. xxxii. part ii. p. 219).

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INTRODUCTION.

In the Introduction to Part I. of this Report, the accounts of the history, bibliography, and anatomy refer not to the Ascidiæ Simplices alone, but to the Tunicata as a whole; still, as the Simple Ascidians were undoubtedly discussed there more fully than the other groups, it seems desirable that the more important points in the history and the structure of the Ascidiæ Compositæ should be given here as an introduction to the description of so many new species of that section of the Tunicata.

HISTORY.

Although Compound Ascidians belonging to the family Botryllidæ were figured as far back as 1555 by Rondeletius, it was not until two hundred years later, when Schlosser and Ellis in 1756 brought before the Royal Society their account of a species of *Botryllus*, that anything was known of the structure of these colonies, and even then their relationship to the Simple Ascidians—some of the main points in the anatomy of which were known nearly two thousand years before—was not suspected. This relationship was made out by the conjoined efforts of several eminent naturalists who investigated the Tunicata during the concluding years of the eighteenth and the opening years of the nineteenth centuries.

Gaertner as early as 1774 evidently saw the relationship of the genus *Distomus*, which he had founded, with the other Tunicata, and Renier in 1793 published similar views in regard to the genus *Botryllus*; but it was left for Cuvier and Savigny, working during the first fifteen years of the present century, the former at the Simple Ascidians and the latter at the Compound, to demonstrate beyond all possibility of future doubt the close affinity between these two groups of the Tunicata. Up to the date of publication of Savigny's immortal "Mémoires" (1816), the Compound Ascidians then known had been confused by the majority of naturalists with the Alcyonaria or with the Sponges. This patient and accurate observer succeeded in determining, from material preserved in spirit, the complete anatomy of a large number of forms, and he founded ten genera, most of which are still recognised as being among the more important types of the Ascidiæ Compositæ. Lamarck about the same time, on the strength of the anatomical

discoveries made by Savigny and Cuvier, instituted the class Tunicata, which he placed between the Radiata and the Vermes in his system of classification.

In 1826 H. Milne-Edwards, while investigating along with Audouin the zoology of the Chausey Archipelago, off the coast of Normandy, made a number of observations upon Compound Ascidians in a living condition, and laid the foundations for his great work upon the group which was published some sixteen years later. He also at the same time was fortunate enough to discover the tailed larva,[1] and he traced its development into the adult Ascidian. Lister's observations, published in 1834, were made partly upon a species of the remarkable genus *Diplosoma*.[2] They referred mainly to the circulation of the blood. About this time Forbes and Goodsir, W. Thompson, Delle Chiaje, and others were steadily adding to the knowledge of the Compound Ascidians, and in 1842 Milne-Edwards' important memoir, "Observations sur les Ascidies Composées des côtes de la Manche," appeared, with its fresh anatomical and embryological discoveries, and its natural system of classification into (1) Botrylliens, (2) Didemniens, and (3) Polycliniens. Milne-Edwards had a great advantage over Savigny and others of his predecessors in having worked upon living material: some of the Compound Ascidians are greatly altered by preservation in alcohol.

Additions to the list of known species were made during the next few years by Forbes, Alder, and several others, and the article Tunicata in Todd's Cyclopædia, published in 1848, gives a good account of the knowledge of the Compound Ascidians at that time. A still more complete account was published some years later (1862) in Bronn's Thierreich. Dr. J. Denis Macdonald's observations upon some of the most remarkable forms of the Ascidiæ Compositæ were made about this time, viz., on *Chondrostachys* in 1858 and on *Diplosoma* in 1859. These excellent researches will be referred to later on in this work.

In 1862 Gegenbaur gave in Müller's Archiv an important account of the anatomy and development of *Didemnum gelatinosum*, and, a few years later, Kowalevsky's great memoir on the development of a Simple Ascidian made its appearance and threw a flood of light upon the interesting and peculiar tailed larva which had been described but not thoroughly investigated nor understood by Milne-Edwards and others. The relationship with the Vertebrata, which Kowalevsky established for the Simple Ascidians, held good of course for all groups of the Tunicata, and the similarity of the main points in structure and development between the larva of the Compound and of the Simple Ascidians has since been demonstrated by many observers.

The important observations of Krohn and Metschnikoff upon the process of gemmation in the Botryllidæ were published a few years later, and Kowalevsky's contributions to

[1] This, however, had been figured long before by Savigny both for Simple and Compound Ascidians (see Mémoires, pl. xi. fig 2-3, *Clavelina borealis*; and pl. xxi. fig. 1, *t*, *Botryllus polycyclus*).

[2] Usually referred to as a *Leptoclinum*.

the elucidation of the same process in other Compound Ascidians, and an important memoir in Russian on their embryology by Ganin, appeared about the same time.

Giard's large work on the Ascidiæ Compositæ, published in 1872, added greatly to the knowledge of the group. It contained careful descriptions of a number of new forms, and the definitions and arrangements of the families and genera, many of which were new, formed welcome and much needed aids to classification.

Since that date most of the works upon the Tunicata have dealt either with the Simple Ascidians or with the Thaliacea, but Della Valle in Italy, and von Drasche in Austria, have done good service in describing new forms amongst the Compound Ascidians, and the last named author has published in his Synascidiæ of the Gulf of Rovigno, a series of probably the most beautiful and life-like plates of Compound Ascidians which have yet appeared. Della Valle has also contributed considerably to our knowledge of the processes of gemmation in the various groups of the Ascidiæ Compositæ, but this question will have to be gone into more in detail further on in the present work.

Lastly, the Challenger Expedition has added a large number of new forms to the list of Compound Ascidians previously known, and some of these, besides the interest attaching to them on account of the localities or the great depths at which they were collected, have remarkable anatomical peculiarities, which render their discovery of some importance in the history of the group.

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ANATOMY.

The following account of the anatomy and histology[1] of the Compound Ascidians deals chiefly with the points in which the groups of these Tunicata differ from the Simple Ascidians and from one another in the arrangement and structure of their various organs, and therefore may be regarded as supplementary to the corresponding section of the Introduction to Part I. of this Report.

The minute anatomy of certain special forms (*e.g.*, *Colella pedunculata*, p. 77, and *Colella thomsoni*, p. 95) will be found in their proper places in the systematic part of the work; and the more important points of novelty and interest exhibited by the Challenger collection will be discussed in the General Summary at the conclusion of the Report.

Classification.

The scheme of classification given in Part I. (p. 25) is retained unchanged, except that the families Cœlocormidæ and Polystyelidæ have been added to Suborder II., the Ascidiæ Compositæ. The same system of nomenclature will still be made use of, and the body, when being described, is supposed to be in the position figured and explained on p. 27 of Part. I.

The Colony.

As all Compound Ascidians reproduce by gemmation, specimens are almost always found to be colonies consisting of a number of members. These members may be called

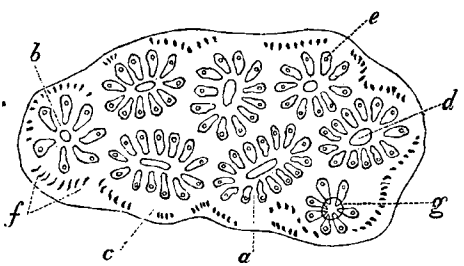


FIG. 1.—A Colony of a Compound Ascidian (*Botryllus*). The Ascidiozooids are arranged in eight systems.

a, a large system formed of fifteen Ascidiozooids; *b*, a small system formed of seven Ascidiozooids; *c*, the test or investing mass; *d*, a common cloacal aperture; *e*, an Ascidiozooid; *f*, the terminal knobs of the vessels; *g*, a system where the common cloacal aperture is fully expanded.

"Ascidiozooids,"[2] and the colony as a whole the "Ascidiarium" or "Cormus." If the Ascidiozooids are arranged in definite groups which can be distinguished from one

[1] For further details in regard to the structure of the Compound Ascidians I may refer the reader in particular to Giard's Recherches sur les Synascidies, and to Della Valle's Nuove Contribuzioni alla Storia Naturale delle Ascidie Composte; and also to the account of the structure of *Colella pedunculata* given further on in this Report (p. 74).

[2] This term was first used, I believe, by Huxley.

another, then the colony may be divided into "systems" or "cœnobii," each system consisting of a group of Ascidiozooids with the surrounding part of the common test or investing mass (see fig. 1, p. 12).

When there are no systems present the Ascidiozooids may either be scattered equally over the colony or be placed irregularly. In the Clavelinidæ, the only Simple Ascidians which reproduce by gemmation, the members of the colony are never arranged in systems. Usually, in the Compound Ascidians, the various Ascidiozooids of a system have their atrial apertures opening into a chamber, the common cloaca, which communicates with the exterior, and thus serves as the common excretory orifice of a number of Ascidiozooids (see fig. 1, where *g* shows the atrial ends of the Ascidiozooids projecting into the common cloaca; see also fig. 3 on p. 16).

The Test.

The ground mass or investing substance of the colony (*c* in fig. 1), in which the Ascidiozooids are imbedded, is homologous with the test or outer tunic of the Simple Ascidians, and ought to be called by the same name. Looked at merely from an anatomical and not from an embryological point of view, a Compound Ascidian colony may be regarded as a number of Simple Ascidians whose tests have completely fused with one another to form a common mass. In some cases this mass in place of being the same throughout is modified in the immediate neighbourhood of the Ascidiozooids, so that each member of the colony seems to have a test of its own, and these tests are then united by the colonial investing mass. Such an arrangement is, however, rarely met with.

In structure, the test of the Compound Ascidians agrees very closely with that of the Ascidiæ Simplices, consequently it is unnecessary to repeat the general characters given in the Introduction to the first part of this Report.[1] In most cases it remains in a comparatively unmodified condition, corresponding to that shown by the Clavelinidæ and the Ascidiidæ amongst Simple Ascidians; and it never assumes the fibrous condition found in most Cynthiidæ. As a rule it is soft, gelatinous, and semi-transparent, and exhibits no differentiation to the eye, except occasionally (*e.g.*, Botryllidæ) when "vessels" are particularly well developed (*f* in fig. 1; see also Pl. I. figs. 2 and 5). It may be rendered opaque by foreign bodies such as sand-grains adhering to or becoming imbedded in its surface (as in the case of many of the Polyclinidæ, *e.g.*, *Psammaplidium*, p. 237, and Pl. XXXI. fig. 9), or by the formation of pigment or of calcareous spicules in the interior. The matrix is homogeneous, or rarely exhibits a very delicate fibrillation under a high magnification; occasionally the outer layer is found to be slightly fibrous in structure. The cells in this matrix are mostly of small size, but may be of almost any

[1] Vol. vi. part xvii. p. 28, 1882.

shape;—round, fusiform, and stellate or branched shapes are the most common (Pl. XI. fig. 1, and many other figures). They comparatively rarely become modified into bladder cells or show much pigmentation. Bladder cells, if present, are usually in the outer layers of the test, and are of rather small size compared with those of Simple Ascidians.

A coloured test may be due to either of two causes—(1) the presence of numerous vessels containing coloured blood-corpuscles, (2) pigment cells in the test. The vessels are usually most abundant at the edges of the colony and close to the surface, while the pigment cells may be scattered evenly all through the test, or aggregated in one part, as in the case of *Colella murrayi* (see p. 117). In some cases (*e.g.*, many Didemnidæ, Pl. XLI. figs. 2, 5) calcareous spicules [1] are formed in the test, and these may become

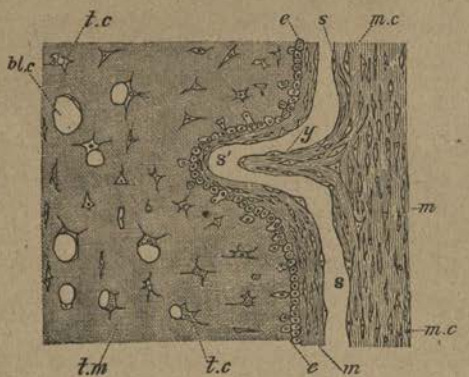


FIG. 2.—A diagrammatic section through part of the mantle and test, showing their relations and the mode of formation of a "vessel."

bl.c, a bladder cell in the test; *e*, the ectoderm; *m*, the mantle; *m.c*, a connective tissue cell in the mantle; *t.c*, test cells; *t.m*, the matrix of the test; *s*, a blood sinus in the mantle; *s'*, its continuation into the test to form a "vessel"; *y*, the septum of the young vessel formed by a continuation of the connective tissue of the mantle.

so numerous as to entirely change the character of the tissue, rendering it hard and brittle, and usually giving it an opaque white colour (see Pl. XXXV. fig. 1).

As in the case of the Ascidiæ Simplices, the test is sometimes penetrated by "vessels" in the form of prolongations from the mantle covered by a layer of ectoderm and containing a blood sinus (see fig. 2). These vessels may be very numerous, and have large terminal knobs or bulbs placed in the superficial layers of the test (as in some Botryllidæ), or they may be only very slightly developed (as in some Polyclinidæ). In some cases they contain powerful bands of muscle-fibres continuous with those of the mantle, and then seem to have changed their function (which was probably respiratory at first [2]) and to

[1] The relation of these spicules to the rest of the test is discussed further at p. 270.

[2] See Herdman, On a New Organ of Respiration in the Tunicata, *Proc. Lit. and Phil. Soc. Liverpool*, 1884-85, p. 39.

have become retractor muscles for the purpose of pulling the Ascidiozooids downwards into the test (as in the case of *Leptoclinum thomsoni*).

In some of the Compound Ascidians certain parts of the test may become very greatly enlarged so as to produce large massive colonies (such as *Atopogaster aurantiaca*, Pl. XXIII. fig. 7; and fig. 5, p. 27), or long peduncles upon which the rest of the colony and the Ascidiozooids are borne (*e.g.*, *Colella pedunculata*, Pl. V. fig. 1, and *Distaplia rallii*, Pl. XVIII. fig. 1, &c.; see also fig. 6, p. 27). Usually in such cases the enlarged part of the test becomes modified. Peduncles, for example, are almost invariably harder and tougher than the rest of the test. The superficial layer of test also frequently becomes slightly modified to form a firmer layer which may be stripped off as a membrane from the surface of the colony. In some cases the outer layer of the test may be prolonged into delicate processes for purposes of attachment (see Pl. XXXV. fig. 3), and such processes may become covered with adhering sand-grains so as to form a protecting sandy investment.

The Ascidiozooid.

The Ascidiozooids or members of the colony are usually placed vertically (at right angles to the upper surface) in the test. In the genus *Botryllus*, however, they are placed nearly horizontally, and in *Diplosoma* and some other forms they are inclined at all angles. The anterior end, indicated by the branchial aperture,[1] is always nearest to the outer surface of the colony, and the antero-posterior axis generally runs along the length of the body (see fig. 3, p. 16).

The Ascidiozooids vary greatly in shape in different groups of the Compound Ascidians. Savigny in 1816 pointed out and figured[2] most of these shapes, and in 1842 Milne-Edwards[3] arranged them in three groups, one characteristic of each of his great sections, Polycliniens, Didemniens, and Botrylliens. These divisions of the Compound Ascidians are no longer recognised, but still it is useful to employ Milne-Edwards' arrangement so far as it relates to the shape of the Ascidiozooids. In his group Polycliniens the body consists of three regions placed one behind the other—first, the branchial or "thorax" (see fig. 3); second, the intestinal or abdomen; and third, the reproductive or post-abdomen. The "thorax," to make use of Milne-Edwards' terms, contains the branchial siphon and branchial sac with all its accessory organs (endostyle, &c.), the nerve ganglion, and the terminal part of the rectum. The abdomen contains the alimentary canal from the œsophagus to the rectum, with any accessory digestive glands or cæca which may be present. The post-abdomen is composed of the reproductive organs—with the exception of the greater part of their ducts, which pass upwards into the abdomen and the thorax —and of the heart. From the posterior end of the post-abdomen occasionally one or

[1] See Part I. of this Report, p. 27. [2] Mémoires, &c. [3] Observations, &c.

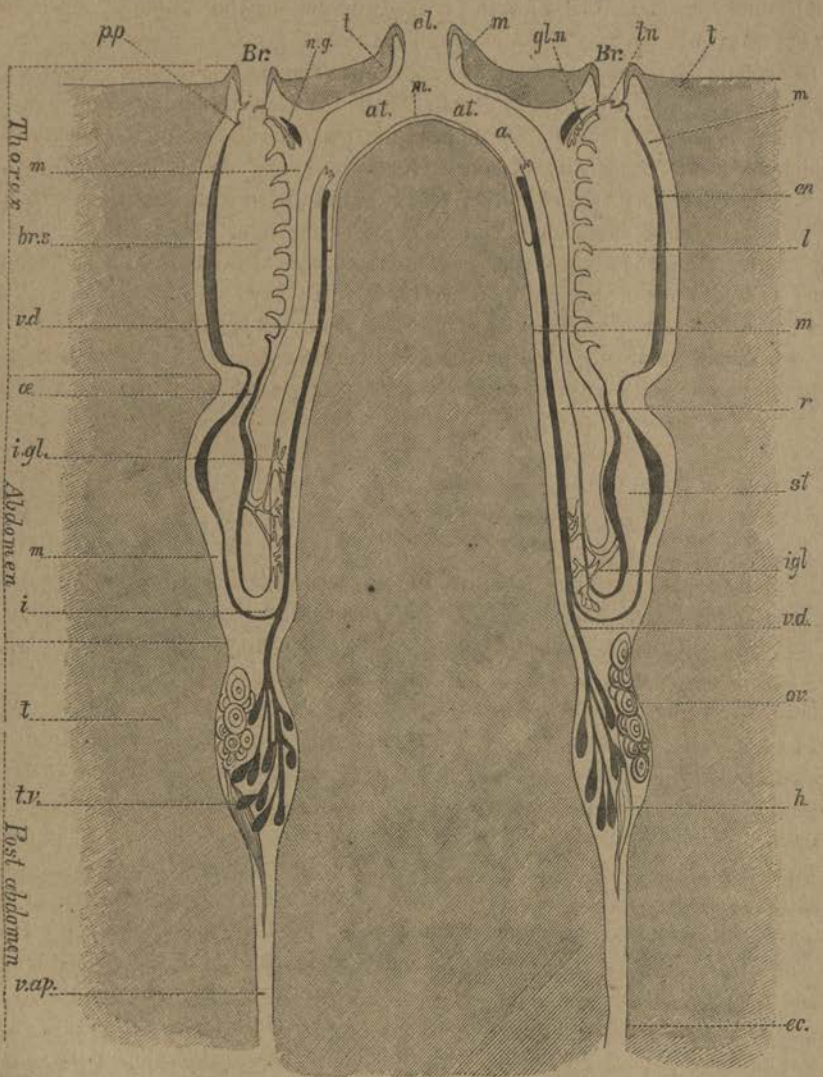


FIG. 3.—Diagram showing a Compound Ascidian Colony composed of two Ascidiozooids united to form a system.

a., anal aperture; *at.*, atrial cavity opening into the common cloacal cavity; *Br.*, branchial aperture; *br.s.*, the branchial sac; *cl.*, common cloacal aperture; *ec.*, the ectoderm bounding the vascular appendage; *en*, endostyle; *gl.n*, neural gland; *h.*, heart; *i*, intestine; *i.gl.*, hepatic gland on the intestine; *l*, languet; *m*, mantle; *n.g.*, nerve ganglion; *œ*, œsophagus; *ov.*, ovary; *p.p*, peripharyngeal band; *r*, rectum; *st*, stomach; *t*, the test or investing mass; *tn*, one of the tentacles; *t.v.*, a testicular vesicle; *v.ap.*, the vascular appendage; *v.d.*, vas deferens. The limits of the thorax, abdomen, and post-abdomen are shown by the dotted lines extending outwards to the left, one at the lower end of the endostyle and another below the intestinal loop.

more "vessels" are continued downwards into the test (see fig. 3, *v.ap.*). The Ascidiozooid is of this form in the family Polyclinidæ. In the group Didemniens there is no post-abdomen. The reproductive organs and the heart are placed in the abdomen alongside the intestine, so that the body consists of two divisions only (Pl. V. fig. 13). The Ascidiozooid is of this form in the following families:—Distomidæ, Didemnidæ, and Diplosomidæ. Finally, in Milne-Edwards' Botrylliens, the body cannot be divided into regions. The alimentary canal, the reproductive organs, and the heart are all placed alongside the branchial sac or project very slightly beyond it (Pl. II. fig. 7). The post-abdomen and abdomen seem to have been drawn upwards into the thorax. The families Botryllidæ and Polystyelidæ have Ascidiozooids of this form.

In some cases the division into the above described regions is very distinct, the body being constricted between them so as to form two (Didemniens) or three (Polycliniens) masses united by narrow pedicles (Pl. XXI. fig. 5); but in other cases, although the regions are anatomically present, they are not apparent without dissection, the body being equally or nearly equally thick all the way down (Pl. XXVI. fig. 4).

The Mantle.

The mantle has precisely the shape of the Ascidiozooid, of which it forms the covering inside the ectoderm. The latter separates it in all parts from the test, with which it therefore never comes into direct contact. The mantle is formed by connective tissue uniting and enclosing bundles of muscle-fibres, nerves, and blood-spaces. In its histology it resembles closely the mantle of the Ascidiæ Simplices. It varies considerably in its thickness and in the condition of its musculature in the different species of Compound Ascidians. In some cases, both longitudinal and transverse (circular) muscle bands are present, and the transverse bands are the strongest and the most regularly placed. Figure 10 on Plate X. shows this condition of the mantle. In others they are placed with very great regularity, and the longitudinal bands are almost absent. In other Compound Ascidians, however (*e.g.*, *Colella ramulosa*, Pl. XV. fig. 17), the longitudinal muscle bands are more marked and more regular than the transverse ones, and, in some cases, the latter are almost absent while the longitudinal bands are then very powerful. In some few cases (*Tylobranchion speciosum*, see Pl. XXII. fig. 4) the muscle bands over the branchial sac are strong, and branch like those of a typical *Ascidia;* usually they are more delicate than in any of the Ascidiidæ. The muscle fibres in the mantle are always unstriped. The sphincters surrounding the branchial and atrial siphons (where the latter opens independently) are usually well marked in Compound Ascidians.

In some forms (*e.g.*, *Colella pedunculata*, see p. 89) the median dorsal part of the mantle near the anterior end of the peribranchial cavity is prolonged to form a diverticulum which varies in size from a scarcely perceptible enlargement to a long spirally coiled

cæcum as large as, or even larger than, the body of the Ascidiozooid (see Pl. V. figs. 11, 12, and 13). This is the incubatory pouch, in which the embryos undergo their development. Its wall is usually thin, and its muscle-fibres are few and delicate.

The mantle apparently does not contract so much at death in Compound as in Simple Ascidians, consequently there is rarely any space between it and the test even in spirit specimens. In some cases, however, contraction does take place, which results in the body of the Ascidiozooid being drawn downwards into the test so that the ectoderm (which connects the mantle and the test) is torn, and the branchial siphon is retracted from the surface.

The mantle is sometimes considerably pigmented, just as in the case of some Simple Ascidians, and may in consequence become very opaque (*e.g.*, *Distaplia vallii*, Pl. XVIII. fig. 5); the pigmentation may be due to the presence of blood sinuses filled with coloured blood-corpuscles, or to pigmented connective-tissue cells. The mantle is bounded both externally and internally by an epithelial layer. The outer of these is the ectoderm, usually a very distinct membrane formed of large and distinctly nucleated cells, and the inner is the parietal layer of the lining membrane of the peribranchial cavity. This latter is formed of squamous epithelium, and the cells are not so clearly visible as those of the ectoderm.

The anterior end of the mantle, forming the branchial siphon, is usually divided into six lobes, which may be very distinct (see Pl. XXV. fig. 9), rarely there are eight (*e.g.*, *Morchellioides affinis*). In some cases there are no lobes, or the margin is irregular. When the Ascidiozooids are arranged in systems the mantle at the atrial aperture may be prolonged to form a projection, the atrial languet (see Pl. XXIX. fig. 15) which contributes to form the edge of the common cloacal aperture of the system.

The Branchial Sac.

This organ varies greatly both in size and structure throughout the Ascidiæ Compositæ (see fig. 4, p. 21, *br.s.*, and also the plates). In the Botryllidæ it is nearly as large as the body of the Ascidiozooid, in the Distomidæ, &c., it is usually about half the size of the body, while in the Polyclinidæ it may be less than one-fourth of the length of the body. Usually the antero-posterior extent of the sac is much the greater, but in some cases (*e.g.*, *Polyclinum minutum*) it is as broad as it is long. It is never thrown either into folds or into minute plications, the corrugated condition in which it is found in some spirit specimens being due, I believe, to contraction on death.

The essential structure of the branchial sac is the same as in the Simple Ascidians, and the three chief systems of vessels[1] are recognisable. The internal longitudinal bars are, however, rarely present. They are seen in the Botryllidæ and in *Symplegma*.

[1] See Part I. of this Report, Introduction, p. 32.

The transverse vessels and fine longitudinal vessels are found in all possible conditions, and the stigmata may vary from small circular openings (Pl. XXV. fig. 14) to very long narrow slits with parallel sides (Pl. VI. fig. 10), but they are never curved. The stigmatic ciliated cells may also vary greatly in form (see Pl. VI. figs. 12, 13; and Pl. XI. fig. 7, &c.). In some cases where the internal longitudinal bars are absent, rudiments of the connecting ducts in the form of papillæ projecting from the transverse vessels are present (*Tylobranchion speciosum*, see Pl. XXII. fig. 9), but generally they are entirely absent except along the dorsal lamina, where they form the series of languets. Horizontal membranes hanging from the transverse vessels are very frequently present, and may be wide or narrow (Pl. XXV. fig. 8 and Pl. XV. fig. 16). The number of rows of stigmata varies from three (*Didemnum savignii*) to about twenty (*Atopogaster aurantiaca*), and the number of stigmata in each row from four or five up to a large number. In the embryos of most of the Compound Ascidians, even of those species which have a large number of rows in the adult, there are four rows of stigmata on each side of the sac.

In *Pharyngodictyon mirabile* (p. 154, Pl. XXI. fig. 12) the branchial sac has the simple structure seen in the genera *Culeolus*, *Fungulus*, and *Bathyoncus* amongst Simple Ascidians.[1] It is composed of two sets of large vessels intersecting at right angles so as to form large quadrangular meshes. Probably the fine longitudinal vessels are undeveloped, and in that case no true stigmata are present.

The Endostyle.

This is generally a very conspicuous organ in the body of an Ascidiozooid, and is relatively larger than in Simple Ascidians. It is sometimes straight, and runs antero-posteriorly, but more usually its course is very undulating, turning first to the one side and then to the other so as to form a series of closely placed folds (Pl. XXII. fig. 6). It never extends beyond the posterior end of the dorsal edge of the branchial sac. It is formed of elongated columnar epithelium, richly ciliated in places.

The Dorsal Lamina.

This may be present in Compound Ascidians, or it may be represented by a series of languets which are, I believe, homologous with the connecting ducts of the branchial sac (see p. 161). When a dorsal lamina is present (*e.g.*, *Botrylloides tyreum*,[2] see Pl. II. fig. 8, *d.l.*) it is a plain membrane with neither transverse ribs nor marginal teeth; it may, however, be corrugated at its free edge, especially near the anterior end.

Languets when present are usually triangular flaps flattened antero-posteriorly

[1] Part I. of this Report, pp. 90, 127, and 165.

[2] Named *Botrylloides purpureum* on the plate, and in the description, p. 41.

(Pl. XI. fig. 10), but they may, on the other hand, be tapering tentacle-like processes (*e.g.*, *Atopogaster aurantiaca*, Pl. XXIII. figs. 11, 12) with no antero-posterior flattening. They are always richly ciliated along the edges.

The Tentacles.

The tentacles are simple in all Compound Ascidians, and are usually few in number and placed at regular intervals round the base of the branchial siphon. Eight and sixteen are usual numbers, but occasionally only four or even two (*Polycyclus cyaneus*, v. Drasche) are present. In other cases they are more numerous, and in *Tylobranchion speciosum* the number is large and the arrangement indefinite, as in a Simple Ascidian. Very often the tentacles are of two sizes, which are then placed alternately. Sometimes the tentacles are richly pigmented.

The Nervous System and other Neighbouring Organs.

The nerve ganglion is usually elliptical in form, and occupies the same position as in the Ascidiæ Simplices: it gives off nerves anteriorly and posteriorly. The mantle in the neighbourhood of the nerve ganglion is frequently pigmented, and in some Compound Ascidians small pigment-spots, which are probably lowly developed sense organs, are found along the edge of the branchial aperture just as in the case of most Simple Ascidians. A second small ganglionic enlargement is said to have been found on a nerve going to the atrial aperture in some species where the edge of the common cloacal aperture is well developed and sensitive.

In close relation to the nerve ganglion, and usually on its posterior side, is placed the neural gland, which is comparatively slightly developed in the Compound Ascidians, and gives off the neural duct running anteriorly and ventrally to open into the anterior end of the branchial sac by the aperture of the dorsal tubercle (see fig. 3, p. 16, *gl.n*). This opening is usually a simple circular or ovate slit (Pl. II. figs. 8, 9) placed in the dorsal line of the prebranchial zone behind the tentacles, and having slightly raised lips which form the inconspicuous "tubercle." The region of the neural duct nearest to the opening is generally enlarged to form an infundibulum with ciliated walls (see Pl. III. fig. 8, *inf.*).

The peripharyngeal bands surrounding the branchial sac at the level of the anterior ends of the endostyle and the dorsal lamina, and defining the posterior border of the prebranchial zone, in most cases bend posteriorly in the dorsal median line to bound a more or less triangular diverticulum from the prebranchial zone. This diverticulum corresponds to the peritubercular area in the Ascidiæ Simplices, but in the Ascidiæ Compositæ it rarely encloses the dorsal tubercle, which is placed considerably further forward (Pl. III. fig. 16).

The Alimentary Canal.

This tube, consisting of the œsophagus, the stomach, the intestine, and the rectum, varies greatly in its size, its arrangement, and its position in the body in the different groups of Compound Ascidians. In the Botryllidæ it lies almost entirely alongside the branchial sac, while in most other forms it extends for a longer or shorter distance behind it. The typical and probably the primitive arrangement is that shown in fig. 4, A., where the œsophagus (*œ.*) commences at the posterior end of the dorsal edge of the branchial sac (*br.s.*) and runs backwards to open into the anterior end of the ovate stomach (*st.*).

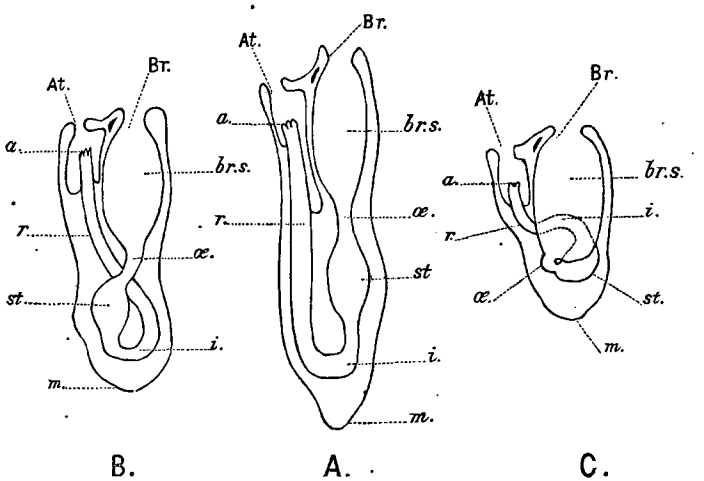


FIG. 4.—Three diagrams showing some of the more important variations of the alimentary canal found in Compound Ascidians. A. is probably the primitive condition, and corresponds to *Ciona* amongst Simple Ascidians. In C. an arrangement is shown, corresponding to *Ascidia*, which has been produced by pulling up the intestinal loop or by a downward extension of the branchial sac. B. shows a twisting of the loop, which causes the stomach to lie on the dorsal edge of the abdomen. B. may very readily be converted into C.

a., anus; *At.*, atrial aperture; *Br.*, branchial aperture; *br.s.*, branchial sac; *i.*, intestine; *m.*, mantle; *œ.*, œsophagus; *r.*, rectum; *st.*, stomach.

The intestine (*i.*) arises from the posterior extremity of the stomach and runs backwards for a short distance, and turns dorsally and then anteriorly to form a narrow loop. It may then be called the rectum (*r.*), which runs forwards alongside the stomach and œsophagus till it reaches the neighbourhood of the branchial sac, where it ends by opening (*a.*) into the peribranchial cavity in the neighbourhood of the atrial siphon (*At.*). From this primitive form two series of modifications have started. In the one the intestinal loop has been drawn forwards so as to lie upon the left side of the branchial sac with the intestine in front of the stomach. This produces the state of affairs found

in the Botryllidæ (fig. 4, C., and Pl. III. fig. 17), where the branchial sac is relatively much larger than in other forms, and the œsophagus runs ventrally to open into the large stomach, which is inclined ventrally and a little anteriorly. The intestine after leaving the stomach runs anteriorly and then dorsally and then turns anteriorly again to become the short rectum. The second series of modifications consists in the twisting of the intestinal loop so that the stomach comes to lie upon the dorsal in place of the ventral edge of the intestine (see fig. 4, B.). This condition is seen in various degrees of perfection in some of the Distomidæ and Didemnidæ.

The œsophagus is usually narrow, but may be of considerable length (Pl. IV. fig. 7). The stomach is thick-walled and large. Sometimes its surface is smooth, but in many cases it has conspicuous longitudinal folds which project as ridges into the interior (Pl. XXX. figs. 6, 7); occasionally these folds are represented by short detached cæca (Pl. XXV. fig. 6). The intestine may be a simple tube, or may be divided into several regions distinguished from one another by their calibre and the thickness of their walls (Pl. XLI. fig. 2). The rectum is always thin-walled, and is sometimes very wide. It may vary in calibre at different points, and sometimes it is folded. The anus may have a large margin, either plain or lobed. In some cases it opens near the posterior and in others near the anterior end of the peribranchial chamber.

Many of the Ascidiæ Compositæ have a system of tubules branching over the wall of the intestine, which clearly corresponds to the digestive gland of a similar nature found in many Simple Ascidians.[1] The duct from this system runs across from the intestine and opens into the stomach. A short cæcum may be present near the posterior end of the stomach at the point where the duct opens (see Pl. III. fig. 21). The exact function of this system is still unknown.

Heart, Blood, &c.

The heart varies in position in the different families. In the Botryllidæ it is placed close to the stomach alongside the branchial sac. In the Distomidæ, &c., it is placed alongside the intestinal loop on the right side, and runs antero-posteriorly. In the Polyclinidæ the heart is placed at the posterior end of the post-abdomen behind the reproductive organs (see fig. 3, p. 16, *h.*), and is bent so as to form a loop concave anteriorly. The structure of the heart and of the blood is the same as in the case of the Simple Ascidians. A large number of the blood-corpuscles may in some cases be pigmented. These are usually opaque white or red or purple.

The so-called vascular appendages, which form prolongations from the bodies of the

[1] See Part I. of this Report, Introduction, p. 49. Roule (Recherches sur les Ascidies Simples des Côtes de Provence) states that this is a system of blood sinuses! I am convinced that in some of the species in which I have investigated it the main duct opens into the alimentary canal.

Ascidiozooids in some species (see fig. 3, p. 16, *v.ap.*; and Pl. V. fig. 13), are really diverticula of the mantle, and are composed of a layer of ectoderm and, inside that, of connective tissue containing two blood sinuses running side by side, and therefore correspond to the blood-vessels of the test in Simple and some Compound Ascidians. The vascular appendages may in some cases (*e.g.*, *Colella concreta*, and many of the Didemnidæ) contain muscle fibres continuous with the musculature of the mantle. Blood sinuses or lacunæ are present in all parts of the body, and form the greater part of the circulatory system.

A mass of a glandular nature, and having usually a yellowish-green colour, which coats the first part of the intestine, is in all probability of a renal nature, and corresponds to the renal vesicles found in many Simple Ascidians (*e.g.*, *Ascidia mammillata*, *Ascidia meridionalis*, &c.).

The Reproductive Organs.

The Ascidiozooids are probably in all cases hermaphrodite, but in many forms the ova and the spermatozoa are produced at different times, and are therefore not found mature together. The usual arrangement[1] is for the ova to form first, and then after they have been laid or have passed into the incubatory pouch the spermatic vesicles commence to develop. This protogynous arrangement of course prevents self-fertilisation.

The genital glands may be placed on the sides of the branchial sac, as in the Botryllidæ, where there is usually an ovary and a group of spermatic vesicles upon each side of the body (see Pl. II. figs. 10, 11). A more usual arrangement is for the genital glands to be placed in the intestinal loop, either alongside the intestine as in the Distomidæ, Didemnidæ, &c. (Pl. V. fig. 13), or projecting beyond the intestine posteriorly to form a shorter or longer post-abdomen (fig. 3, p. 16) as in the Polyclinidæ (Pl. XXI. fig. 5).

The ovary is simply a group of more or less completely developed ova and germinal cells (Pl. VII. fig. 7), and there is probably no true oviduct present.[2] The spermatozoa may be formed in a single large testis (as in *Didemnum savignii*, Pl. XXXIV. fig. 2) or in a large number of small testes or spermatic vesicles (fig. 3, p. 16) which vary in shape and arrangement in the different groups (see descriptions of the genera and species in the Systematic Part of the Report). A distinct vas deferens is always present, and it is usually a very conspicuous tube which runs alongside the rectum in its entire length (Pl. XXV. fig. 6). In some cases (*Leptoclinum speciosum*) the vas deferens commences by coiling spirally around the large testis. In other forms the vas deferens is convoluted in its entire course. It opens into the peribranchial cavity close to the anus.

[1] Della Valle states that most are protandrous. That is not my experience, as will be seen in the description of the species further on in the Report, see also Summary at end.

[2] The evidence in regard to the oviduct is very conflicting. Some observers describe it as being present in many forms, others say that it is never found in any Compound Ascidian. I have been unable to find it in any I have examined.

Usually the embryos undergo their entire development in the body of the parent, either in the peribranchial cavity or in a special incubatory pouch, and do not pass into the outer world until they have become completely developed tailed larvæ.

Gemmation.

The budding of Compound Ascidians is a very important process—(1) because it is a very common method of reproduction with most species, and (2) because it has a most important bearing upon the characteristics of the colony.

Reproduction by gemmation takes place in a number of different ways amongst the Ascidiæ Compositæ, in fact nearly every species in which the process has been carefully examined has been found to have a method more or less peculiar to itself. Most of these methods, however, fall into one or other of a few main types of budding, and in all cases the process may be considered as consisting of the giving off from the parent Ascidiozooid of a number of cells containing representatives of the three primary layers of its body, ectoderm, mesoderm, and endoderm.

Giard in 1872[1] recognised four distinct methods of budding which he called stolonial, pallial, ovarian, and pyloric, and as these names are useful in indicating the positions of the buds, they may be retained with advantage.

Stolonial is the process seen typically in the Clavelinidæ amongst Simple Ascidians, but found also sometimes in the Botryllidæ (see p. 59). Here the bud is formed from the enlarged knobs upon the so-called "vessels" or stolons, which are really prolongations of the ectoderm and mantle of the posterior part of the body, and contain prolongations of the vascular sinuses of the mantle (see fig. 2, p. 14).

Pallial budding is seen also in the Botryllidæ, as was shown long ago by Krohn and by Metschnikoff, and it is by this process that the systems in the colony are mainly formed. The bud is produced as a lateral outgrowth from the body of the parent Ascidiozooid.

Ovarian budding is found in the Polyclinidæ, where the reproductive organs extend behind the alimentary canal to form what is called the post-abdomen. This region of the body gives rise to buds either by breaking up into a number of pieces or by giving off processes. This method of budding is really the same as the stolonial. In the first place there are several cases known which seem to be intermediate between the two, and where it is impossible to say definitely which process is followed; and secondly, the post-abdomen is simply a vascular appendage or stolon which has become in great part filled up by the large reproductive organs of the Polyclinidæ, and the process given off from the post-abdomen has exactly the same structure as the knob upon one of the vessels of the Botryllidæ.

[1] Recherches sur les Synascidies, *Archives d. Zool. expér.*, vol. i. p. 570.

The pyloric method of budding is seen in the Didemnidæ, and the buds are formed as enlargements upon the ends of long tubular projections from the body-wall in the region where the thorax joins the abdomen. Such projections have precisely the same structure as the vessels in the Botryllidæ, but of course differ from them in position.

In the Diplosomidæ, and some Didemnidæ, an interesting modification of pyloric budding is found, in which the new Ascidiozooid is formed of two buds[1] from the parent body, which give rise to the thorax and the abdomen respectively, and only unite late on in their development. Della Valle[2] has added considerably to our knowledge of this method of gemmation, and has shown that the thoracic bud is derived from the wall of the peribranchial cavity of the parent, while the abdominal bud is formed as a diverticulum from the œsophagus.

This author states that in the Botryllidæ buds are only formed from the parietal layer of the peribranchial membrane, and are never formed in connection with the vascular prolongations of the ectoderm as had been declared by previous investigators. I have been able to satisfy myself, however, that Della Valle is mistaken on this point, and that, in the case of one species at least (*Sarcobotrylloides wyvillii*, see p. 59), buds are formed in the dilatations on the vessels of the test (see Pl. IV. fig. 13), and therefore probably the observations of Milne-Edwards, Giard, and others, in which the "marginal tubes" were described as being connected with reproduction by gemmation, were perfectly correct.

Wherever it is formed, I believe that the bud always contains (1) a cellular coating derived from the ectoderm of the parent; (2) some mesoderm cells, usually in the form of young ova; (3) some endoderm cells, either in the form of a diverticulum from some part of the alimentary canal of the parent, or as a group of undifferentiated blood-corpuscles, which in the young animal are formed from the hypoblast. The young bud soon takes the form of two concentric cellular layers, the primitive ectoderm and endoderm, with a few mesoderm cells between. The endodermal sac then becomes constricted at two points so as to divide its cavity into three sacs, the middle one becoming the alimentary canal and the two others joining to form the peribranchial cavity of the adult. The primitive alimentary canal soon divides into a larger anterior part, the future pharynx or branchial sac and a smaller posterior region, the future stomach and intestine. The stigmata form as slits in the double membrane separating the lumen of the branchial sac from the peribranchial cavity, the intestine elongates, and other organs begin to make their appearance. The further course of the development of the bud differs somewhat in the different groups of Compound Ascidians.[3]

[1] According to Jourdain's recent researches, however (*Comptes rendus*, t. c. p. 1512, 1885), the two buds arise as a single outgrowth from the œsophageal region of the parent Ascidiozooid, and afterwards separate.

[2] Nuovi Contribuzioni alla Storia Naturale delle Ascidie Composte, *Reale Accad. dei Lincei*, Roma, 1881.

[3] For further details of the process of gemmation in the genus *Colella*, see pp. 90 and 101.

DESCRIPTION OF THE GENERA AND SPECIES, &c.

In the following specific descriptions I have followed the same system as that which was adopted in the case of the Simple Ascidians described in Part I. of this Report. The only point which requires special explanation is the method of measurement which I have employed, and which is shown in the accompanying diagrams.

In the case of a sessile massive colony, such as the one in fig. 5, the "length," AB, is the distance from the point of attachment, B, to the highest point on the top of

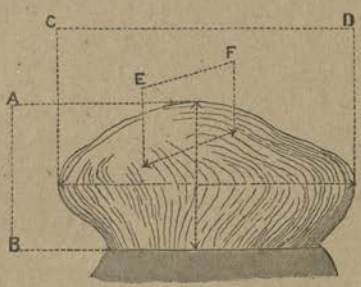


Fig. 5.

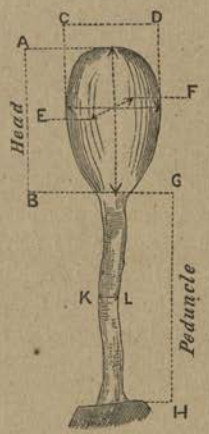


Fig. 6.

Fig. 5.—Diagram of a sessile massive colony to show the length (AB), the breadth (CD), and the thickness (EF).
Fig. 6.—Diagram of a stalked colony to show the "head," the "peduncle," and the various measurements.

the colony, A; the "breadth," CD, is the greatest horizontal diameter, and the thickness, EF, is the greatest (or the average) diameter at right angles to CD, not necessarily in the same plane. In the case of a pedunculated colony (see fig. 6) the dimensions of the "head" and of the "peduncle" are given separately. AB is the length, CD the breadth, and EF the thickness of the head; while GH is the length and KL the thickness of the peduncle. The length and the breadth are, except when the contrary is stated, the extreme length and breadth, but the thickness is usually the average or most

general thickness. In the measurements of an Ascidiozooid, the length is the entire antero-posterior extent from the branchial aperture to the posterior end of the body, exclusive of the vascular appendage when present, the breadth is the greatest dorso-ventral extent, and the thickness is the distance from the right to the left hand side of the body.

ASCIDIÆ COMPOSITÆ.

The Ascidiæ Compositæ, from which I exclude the family Clavelinidæ, may be defined as fixed Ascidians which reproduce by gemmation so as to form colonies in which the Ascidiozooids are imbedded in a common test or investing mass.

This suborder, then, is readily distinguished from the Thaliacea and the Larvacea, and from the Ascidiæ Salpiformes, all of which are free swimming; but although a typical Compound Ascidian may readily be separated by well-marked characteristics from a typical Simple Ascidian, it is very difficult if not impossible to frame a definition which will hold good for all the Ascidiæ Compositæ, while excluding all the Ascidiæ Simplices.

There are series of forms which bridge over, I believe, every gap which has been pointed out as existing between the two groups, and at the present time I find myself unable to fix upon a single satisfactory character by which to distinguish the Compound from the Simple Ascidians. This is not to be wondered at, however, when we consider the great amount of individual variation, and the difficulty of defining the limits of allied species and genera in the Tunicata; and it even seems perfectly natural when we investigate the course of the phylogeny of the group, and find that in all probability the Compound Ascidians are polyphyletic, having been derived from several distinct groups of ancestral Simple Ascidians (see further on in this Report under Summary). They are thus a semi-artificial assemblage, consisting of those fixed[1] Ascidians which have retained or acquired the power of reproducing by gemmation, so as to form colonies, and in which the Ascidiozooids have become so intimately united that their tests form a common colonial mass.

Savigny in 1815[2] first rescued the Compound Ascidians from the Alcyonaria with which they had previously been associated, and demonstrated their affinity with the other Tunicata. In the Tableau Systématique, Savigny gives no formal statement of the characters by which he distinguished the Simple from the Compound Ascidians, but it is evident from some passages in his 3e Mémoire that he relied chiefly, if not entirely, for their separation upon the arrangement of the Ascidiozooids of the Compound forms around a central cloaca, a character which he declared was visible even in the young embryo. In this latter point he was mistaken, and it seems rather singular that he should have laid such stress upon the union of the atrial apertures when we find that he

[1] *Culocormus huxleyi* seems to be unattached, but is probably not free-swimming.

[2] Observations sur les Alcyons gélatineux à six tentacles simples.

describes and figures their separate and independent existence in *Diazona* and *Distoma*, two of the genera of his Téthyes Composées. *Clavelina* in his system is placed—rightly, I consider—next to the "Phallusiæ Cionæ" (the modern genus *Ciona*) among the Ascidiæ Simplices.

Savigny classified the ten genera which he recognised amongst Compound Ascidians by means of characters taken from the branchial and atrial apertures. But although such characters are most useful and constant marks of affinity in the Simple Ascidians, they fail signally as applied by Savigny to the Compound forms, and result in the separation of his closely allied genera *Didemnum* and *Eucœlium*, while *Diazona*, *Distoma*, and *Sigillina* are thrown together in one group, although really belonging to distinct families, and *Eucœlium* is placed with *Botryllus*, a genus with which it has certainly no close relationship.

Lamarck's classification of the Tunicata, published about the same time, was based upon the arrangement of the Ascidiozooids in the colony, but the result was no better than that obtained by Savigny's method, since *Polyclinum* was united with *Polycyclus* and *Botryllus*, *Eucœlium* was united with *Aplidium*, and *Distomus* was grouped along with *Sigillina*, while *Aplidium*, *Polyclinum*, and *Sigillina* were widely separated.

Cuvier, writing shortly afterwards, refused to accept the majority of Savigny's and Lamarck's genera, on the ground that they were not sufficiently distinct from one another. Subsequent investigators have not supported him in this view. Savigny's genera are still nearly all retained, and some have even been broken up into several groups now regarded as distinct genera.

The next classification of importance is that of Milne-Edwards, published in 1841, and one of the most notable features of his arrangement is that it involves the separation of the Clavelinidæ (at that time the two genera *Perophora* and *Clavelina*) as a distinct group, the Ascidiæ Sociales, occupying an independent position between the Simple and the Compound Ascidians. He defined this new group as comprising Ascidians which reproduce by buds as well as by eggs, and which live united by common radiciform prolongations, but which otherwise are free of all adhesion to one another. He distinguished the Simple Ascidians as forms which never reproduce by gemmation and are never found in groups united by a common tegumentary tissue; while he separated the Compound from the Social Ascidians on account of their possessing a test common to all the members of the colony. If we unite the Simple and Social Ascidians, which, as I have shown in the first part of this Report,[1] there is reason for doing, we shall have, according to Milne-Edwards, the Simple and Compound Ascidians distinguished merely by the members of the colony in the latter being united by a common test, while in the former each individual has its own distinct tunic. This character, although much better than the one made use of by Savigny, is, as we shall see later on, by no means an infallible guide.

[1] See vol. vi. part xvii., where the Clavelinidæ are treated as a family of the Ascidiæ Simplices.

Milne-Edwards classified the genera of the Compound Ascidians in three "tribes," the "Polycliniens," the "Didemniens," and the "Botrylliens," an arrangement which with our present knowledge of the group still seems fairly natural in some respects. These three divisions are distinguished by such anatomical characters as the relations of the other viscera to the branchial sac. In the "Polycliniens" the body has three regions—the "thorax," containing mainly the branchial sac; the "abdomen," formed chiefly of the stomach and the greater part of the intestine; and the "post-abdomen," having the reproductive organs and the heart. In the "Didemniens" there are only two regions—thorax and abdomen—the reproductive organs and heart being placed on the intestine. In the third group, the "Botrylliens," the viscera form a single mass in which the alimentary canal lies alongside the branchial sac. The first and last tribes are natural groups, and correspond respectively to the modern families Polyclinidæ and Botryllidæ, but the second tribe, the Didemniens, is rather too wide in its range, and includes forms which are not closely related. Milne-Edwards, however, subdivides it into two groups, the "unistellés" and the "bistellés," of which the former is a very natural group, the modern family Didemnidæ.

This arrangement of the Ascidiæ Compositæ was generally accepted until 1872, when Giard published an important memoir,[1] in which he gave a classification based mainly upon the method of gemmation. He divided the Synascidiæ (in which he included the Social Ascidians of Milne-Edwards) into three great groups—(1) the Catenatæ, in which the buds are formed at the base or posterior end of the body; (2) the Glomeratæ, in which the buds are developed from the region of the reproductive organs of the parent; and (3) the Reticulatæ, in which the buds are formed as outgrowths from the part of the body where the thorax and abdomen join.

The group Catenatæ includes three families, the Clavelinidæ, the Perophoridæ, and the Botryllidæ, but M. Giard gives no sufficient reasons for placing the first two families in the Compound Ascidians, and as von Drasche has since pointed out, the third one does not really exhibit the essential character of the Catenatæ. The second group, the Glomeratæ, corresponds to Milne-Edwards' "Polycliniens," in addition to his "Didemniens bistellés," and is divided into two families, the Polyclinidæ and the Distomidæ, both of which are still retained, but have undergone some changes in constitution. The "Didemniens unistellés" correspond to Giard's third group, the Reticulatæ, and are characterised by gemmation taking place from the region at the posterior end of the branchial sac and by exhibiting the phenomenon of embryonic blastogenesis. This is a natural enough section, which includes two distinct families, the Didemnidæ and the Diplosomidæ, which Milne-Edwards to a certain extent confused with one another. The Glomeratæ cannot stand without several changes which have since been made by von Drasche, and which really reduce it merely to Milne-

[1] Recherches sur les Ascidies Composées ou Synascidies.

Edwards' section "Polycliniens." Giard's memoir contributed largely to the knowledge of the Compound Ascidians, especially in regard to methods of gemmation, but his classification did not make much advance upon that of Milne-Edwards.

Della Valle, writing in 1877, accepts Giard's arrangement with one change which is of importance. In the Catenatæ he places *Diazona* as a third family, the Diazonidæ, in addition to the three, Perophoridæ, Clavelinidæ, and Botryllidæ, recognised by Giard.

We come now to Dr R. von Drasche, the latest authority on the Compound Ascidians, who, both in his preliminary note published in 1882 and in his detailed memoir on the Synascidiæ of the Gulf of Rovigno, wisely abstains from any attempt to form great divisions, and merely groups the genera in a series of carefully chosen families. Of these, the Botryllidæ correspond to Milne-Edwards' old section "Botrylliens," while the Didemnidæ and Diplosomidæ are identical with Giard's families bearing the same names. The Polyclinidæ and the Distomidæ do not correspond exactly to any of Giard's families, but the former are Milne-Edwards' "Polycliniens" without change.

A new family, the Chondrostachyidæ, has been formed for the reception of Macdonald's *Chondrostachys* and von Drasche's *Oxycorynia*, remarkable forms in which the Ascidiozooids are all placed upon a common peduncle penetrated by large vascular canals. I am not inclined to admit the necessity for this new family, and a number of the most interesting new forms obtained during the Challenger Expedition are intermediate, I believe, between von Drasche's *Oxycorynia* and Della Valle's *Distaplia*, and so bridge over the gap between the Chondrostachyidæ and the Distomidæ as defined by von Drasche. The two remaining families of von Drasche's system, the Clavelinidæ and the Perophoridæ, are, I consider, more closely allied to the Simple than to the Compound Ascidians. The genus *Diazona* I regard as a connecting link between the Clavelinidæ and the Chondrostachyidæ, and I find myself unable to decide whether it should be placed amongst the Simple or the Compound Ascidians. After all it is a matter of secondary importance where exactly the artificial line separating the two groups should be drawn.

Several new genera have been added by the Challenger investigations, but they nearly all find places in some of the above mentioned families. One of the most remarkable is *Cœlocormus*, for which a new family, the Cœlocormidæ, must be instituted. I have added, also, a second new family, the Polystyelidæ, formed for the reception of Giard's genera *Polystyela* and *Synstyela*, and some allied forms, all of which have up till now been regarded as Simple Ascidians, along with some new species obtained during the Challenger Expedition. My reasons for taking this step, and an account of the probable affinities of the group, will be given further on in the Report (p. 322, and Summary).

Dr von Drasche does not define the Synascidiæ, and from one or two passages in his memoir it seems probable that he is in very much the same position in which I now find myself, viz., unable to detect any character or combination of characters which will serve

to distinguish Simple from Compound Ascidians. Reproduction by gemmation and the formation of colonies in the latter group will not hold, since it is possible to pass from *Ciona*—a typical Simple Ascidian—to *Distoma* and the very centre of the Compound Ascidians through the following series of forms which show a perfect gradation of these characters:—*Ciona*, *Rhopalæa*, *Ecteinascidia*, *Clavelina*, *Diazona*, *Chondrostachys*, *Oxycorynia*, *Distoma*.

The formation of common cloacal cavities, canals, and apertures cannot be considered as a diagnostic feature of the Compound Ascidians. Although recent investigations by Giard and others upon living material have demonstrated their presence in some genera in which they were previously unknown, yet there are some forms considered by all authorities as Synascidiæ, such as *Chondrostachys*, *Diazona*, *Distoma*, and others, in which the atrial apertures of the Ascidiozooids open independently on the surface of the colony, and no common cloaca is formed.

Lastly, we come to characters taken from the condition of the test, but these break down like the others. In the first place, in passing along the series of forms mentioned above as connecting *Ciona* and *Distoma*, we encounter all stages between a distinct test or tunic for each individual and a common mass in which a number of Ascidiozooids are imbedded. And, secondly, the remarkable group of Polystyelidæ, which were briefly characterised by Giard in 1874, present many of the characters of highly differentiated Simple Ascidians (the Cynthiidæ) along with the supposed Synascidian feature of a colony composed of many Ascidiozooids completely buried in a common test.

Thus all the diagnostic features usually employed fail utterly, and we find that, as our knowledge of the two groups extends, it becomes more and more difficult to distinguish even in an artificial and arbitrary manner between Simple and Compound Ascidians. The condition of the test is probably the best distinguishing feature to employ, but it must be remembered that, as I have just shown, it will not hold good in all cases. As a general rule, however, in the Ascidiæ Compositæ the Ascidiozooids forming the colony have not separate tests, but are imbedded in a common investing mass, while in the Ascidiæ Simplices, when colonies are formed, the Ascidiozooids remain partially distinct from one another and each retains its own test.

The mutual relation of the different families of the Ascidiæ Compositæ is a very difficult matter to determine on account of the peculiarity of their evolution. They seem to form, when expressed diagrammatically, a network rather than a tree-like figure, and this is due, I believe, to the group being formed of several distinct branches which have arisen at different times from different groups of the Simple Ascidians and have become modified so as to form, in some cases, divergent and in others convergent lines. This will be discussed more fully further on in the Report in considering the phylogeny of the group, and the arrangement of the various families according to their natural affinities may be postponed till then (see Summary and General Remarks).

The order in which the families and genera are placed in the following systematic part of this Report is, as a lineal arrangement always must be, more or less artificial. I have followed, as a general rule, the order adopted by von Drasche with the few modifications indicated in the criticism of his arrangement given above, and with the addition of the groups now formed for the reception of the species new to science.

Family I. Botryllidæ.

Colony usually thin and incrusting, sometimes in the form of thick fleshy masses.
Systems circular, elliptical, or forming branched lines. Common cloacal openings distinct, usually lobed.
Ascidiozooids short, and not divided into regions.
Test usually soft, traversed by numerous vessels with large terminal knobs.
Branchial Sac large and well developed, internal longitudinal bars present, stigmata numerous.
Dorsal Lamina in the form of a plain membrane.
Tentacles simple, not more than sixteen in number.
Alimentary Canal placed alongside the posterior part of the branchial sac.
Reproductive Organs on both sides of the body.
Gemmation lateral, from the bodies of the Ascidiozooids; and also stolonial, from the ectodermal processes or vessels in the test.

This family occupies the highest position amongst Compound Ascidians on account of the considerable differentiation attained by most of its members. It corresponds to Savigny's genus *Botryllus*,[1] and to Milne-Edwards'[2] two genera *Botryllus* and *Botrylloides*, but was not raised to the rank of a family until the publication of Giard's work upon the Synascidiæ in 1872.[3] Since that date it has been regarded as a well-marked family by all writers, and has been discussed in particular by Della Valle[4] and by von Drasche.[5]

As first defined by Giard in 1872, the Botryllidæ included only thin incrusting colonies, but if the forms included in the modern genera *Polycyclus* and *Sarcobotrylloides* are to be retained in the family—a matter in regard to which there can be no doubt—the amended definition given by von Drasche, and allowing of the admission of thick fleshy colonies, must be accepted. All conditions between the very thin and delicate

[1] Mémoires sur les Anim. sans Vert., 2e Partie, 1re fasc., tableaux systematique, p. 197, Paris, 1816.
[2] Observations sur les Asc. Comp., &c., *Mém. Acad. Sci. Paris*, t. xxviii., 1842.
[3] Recherch. sur les Asc. Comp., &c., *Archives d. Zool. expér.*, t. i. p. 616, 1872.
[4] Contribuzioni alla storia naturale delle Ascidie Composte del Golfo di Napoli, &c., Napoli, 1877.
[5] Die Synascidien der Bucht von Rovigno, Wien, 1883.

gelatinous films formed by some species of *Botryllus*, and great thick lobed solid masses as in *Sarcobotrylloides*, may be found, and they all belong to the family Botryllidæ.

The systems vary greatly in shape in the different genera, but they are always conspicuous, and usually clearly defined (see Fig. 7, p. 35). The common cloaca of the system is usually large and conspicuous, even in spirit specimens. It has a more or less well-marked membranous margin and is frequently lobed, a lobe corresponding to each Ascidiozooid in the system.

The Ascidiozooids are distinctly marked on the outside of the colony, and are characterised by their short and undivided bodies, showing no distinction between branchial and visceral regions such as is found in most other Compound Ascidians. The branchial aperture is described by von Drasche as "toothless" in his definition, but this cannot be accepted as an invariable characteristic, as *Botrylloides purpureum* has the branchial aperture distinctly lobed (see p. 43 and Pl. II. fig. 7, *br*). The atrial aperture is generally provided with a single lobe or projecting languet which joins the membranous margin of the common cloaca.

The common test is soft and gelatinous. It is usually very transparent, and contains a great many branched "vessels" or ectodermal processes from the Ascidiozooids containing blood and ending in swollen knobs or bulbs. The branchial sac is always of very large size, larger than in any other family of the Ascidiæ Compositæ. It extends over the entire length and breadth of the body of the Ascidiozooid, the alimentary and reproductive viscera being placed alongside it. There are usually about twelve rows of stigmata, and at the middle of the series there are from ten to thirty in each row. The dorsal lamina is a plain narrow membrane which may be corrugated, but has no distinct teeth nor ribs. The tentacles are not large, and never exceed sixteen in number. They may be reduced to two. Four larger and four smaller, placed alternately, is the characteristic arrangement.

The alimentary canal lies on the side of the posterior one-third or one-fourth of the branchial sac, and is mainly directed transversely. The stomach is large, and is usually globular in shape. It is folded longitudinally. On each side of the body, about the middle, lies the ovary, more or less surrounded by the spermatic vesicles. Thus two hermaphrodite genital glands are present. Gemmation usually takes place from the sides of the Ascidiozooids, but in *Sarcobotrylloides* at least buds may also be formed in the dilatations on the ectodermal processes or vessels of the common test (see Pl. IV. fig. 13). Consequently the lateral budding can no longer be regarded, as it was by von Drasche, as a diagnostic feature of the Botryllidæ, although it is certainly the characteristic method of reproduction by gemmation in the family. The exceptional method found in *Sarcobotrylloides* will be discussed at length further on (see p. 59).

Lamarck[1] in 1815 formed the genus *Polycyclus* for a Botrylloid species producing a thick fleshy colony. This genus was not recognised by Savigny, who in 1816[2] divided the single genus *Botryllus* into two sections :—(1) "Botrylli stellati" having the Ascidiozooids of each system placed in one row, and (2) "Botrylli conglomerati," where the Ascidiozooids form several rows. The latter included only one species, *Botryllus conglomeratus*, Gaertner, said to be found on the English coast. There is considerable doubt as to this species. Possibly it does not belong to the Botryllidæ.[3] Savigny further divided the Botrylli stellati into—(1) those where the Ascidiozooids are cylindrical and have the branchial and atrial apertures close together, and where the margin of the common cloaca is not distinct; and (2) those where the Ascidiozooids are ovoid and have the apertures distant, and where the margin of the common cloaca is always visible. This was a very natural classification, and it has been upheld by almost every writer on the Botryllidæ

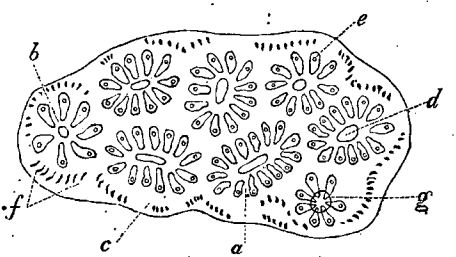


FIG. 7.—A Colony of a Compound Ascidian (*Botryllus*). The Ascidiozooids are arranged in eight systems.

a, a large system formed of fifteen Ascidiozooids; *b*, a small system formed of seven Ascidiozooids; *c*, the test or investing mass; *d*, a common cloacal aperture; *e*, an Ascidiozooid; *f*, the terminal knobs of the vessels; *g*, a system where the common cloacal aperture is fully expanded.

since. Milne-Edwards recognised the value of the distinction, and in 1841[4] raised the two groups to generic rank by founding the new genus *Botrylloides* for Savigny's first tribe of species; *Botryllus* being restricted to the second series of forms. As Giard and others have pointed out, these two genera differ not only in the shape of the Ascidiozooids and in the common cloacal aperture, but also in the shape of the systems composing the colony (compare Fig. 7 with Fig. 8, D and E, p. 39).

Della Valle[5] showed in 1877 that Lamarck's old genus *Polycyclus*, which, although it had been employed by some authors (*e.g.*, Risso,[6] Delle Chiaje,[7] and Grube[8]), was by no

[1] *Mem. Mus. Hist. Nat. Paris*, t. i. p. 340.

[2] Mémoires sur les Anim. sans Vert.

[3] From the description and figure given by Pallas (Spicilegia Zool., fasc. 10, Berolini, 1774, p. 39, Tab. iv. fig. 6) it is evident that the animal in question is a Compound Ascidian; it is, however, impossible to say with any certainty even the family to which it belongs. The figure seems to me much more like one of the Polyclinidæ than one of the Botryllidæ. It is not unlike a small colony of *Amaroucium proliferum*. Consequently, I think Savigny's second section may be regarded as having been probably founded upon a mistaken identification, and may now be suppressed.

[4] Observations sur les Asc. Comp., &c.

[5] Contrib. alla Storia Nat. d. Asc. Comp., &c., p. 22.

[6] *Mém. Mus. Hist. Nat. Paris*, 1826, t. iv. p. 280.

[7] Descriz., &c., vol. iii. p. 19.

[8] Die Insel Lussin, &c., p. 64, Breslau, 1864.

means generally accepted, was really worthy of being regarded as a distinct genus. Della Valle consequently divided the family into three genera:[1]—*Botryllus*, *Polycyclus*, and *Botrylloides*. In his elaborate work on the Compound Ascidians of the Gulf of Rovigno, published in 1883, von Drasche adds a fourth group, *Sarcobotrylloides*, for forms which bear the same relation to *Botrylloides* that *Polycyclus* does to *Botryllus*. His classification of the Botryllidæ is as follows:—

Family.	Genus.	Subgenus.
Botryllidæ,	*Botryllus*,	*Polycyclus.*
		Botryllus.
	Botrylloides,	*Sarcobotrylloides.*
		Botrylloides.

This arrangement seems to agree fairly well with the present knowledge of the group, and as the specimens in the Challenger collection can all be referred to one or other of these groups, the only modification which I suggest is that the four subgenera should be regarded as distinct genera. They seem to me to be nearly equidistant from one another, and I think it would be quite as natural to unite *Polycyclus* and *Sarcobotrylloides*, the two massive groups, and distinguish them from *Botryllus* and *Botrylloides*, the two incrusting groups, as to adopt von Drasche's arrangement. Consequently it seems better to avoid the unnecessary complication of recognising groups of two ranks between the species and the family, and simply to consider the Botryllidæ as including four genera:—

Botryllus, Gaertner and Pallas.
Polycyclus, Lamarck.
Botrylloides, Milne-Edwards.
Sarcobotrylloides, von Drasche.

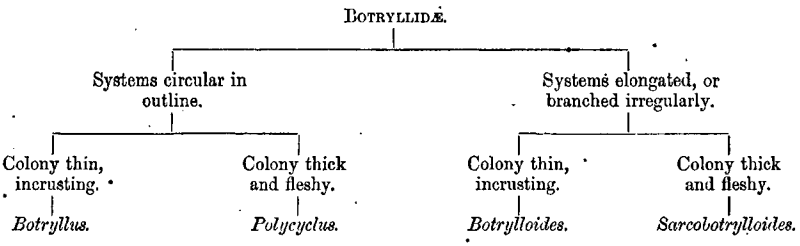
It is a remarkable fact that the common genus *Botryllus* is not represented by any specimens in the Challenger, "Porcupine," or "Lightning" collections. This is partially explained by *Botryllus*, in the restricted sense, being almost entirely a shallow water genus, most of the known species being found at or about low water mark on coasts, while the dredging operations of these expeditions were mainly carried on in deep water. Still a good deal of shallow water investigation was done by the Challenger at some localities, such as Port Jackson, Kerguelen Land, the Philippine Islands, and Japan, and the total absence of species of *Botryllus* from the collections seems to indicate that that genus is by no means so abundantly represented in other parts of the world as it is on the north-western coasts of Europe.

Sarcobotrylloides and *Polycyclus* occur in the "Porcupine" collection, but all the Challenger Botryllidæ belong to the genus *Botrylloides* in the restricted sense. On the

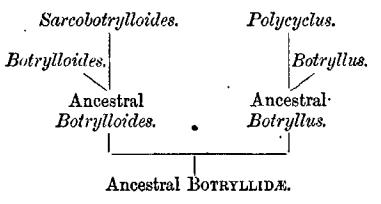
[1] He calls them subgenera, but treats them as genera.

whole the Botryllidæ are feebly represented in the collections compared with most of the other groups and compared with the part they play in the British Ascidian fauna.

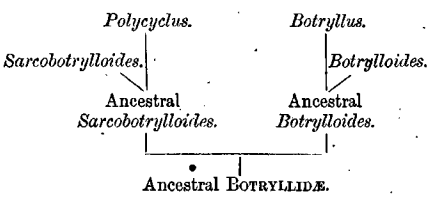
The four genera may be distinguished by the following characters :—



It is a difficult question to determine whether, in the ancestral history of the group, the modification of the systems or of the colony took place first, whether, in fact, Scheme A or Scheme B most nearly represents the phylogeny of the family.



Scheme A.



Scheme B.

It must also be left doubtful whether in Scheme A the thin (*Botryllus*) or the thick (*Polycyclus*) condition of the colony was the more primitive ; and whether, in Scheme B, the irregular (*Botrylloides*) or the regular (*Botryllus*) condition of the system was the more primitive. Probably both in the case of the colony and of the system the extreme forms which we see at the present day diverged from intermediate forms ; and the ancestral *Botryllus* of Scheme A formed a moderately thick colony, which might become reduced into a *Botryllus* or increased to form a *Polycyclus*, while the ancestral *Botrylloides* of Scheme B had an irregular arrangement of Ascidiozooids, which became modified on the one hand into regular circular systems as in *Botryllus*, and on the other hand into long branching lines as in *Botrylloides* (see Fig. 8, D and E, p. 39).

Botrylloides, Milne-Edwards.

Botryllus, Savigny, Mémoires, &c., 1816. In part.
Botrylloides, Milne-Edwards, Observations, &c., 1842. In part.
Botrylloides, Forbes and Hanley, British Mollusca, 1853. In part.
Botrylloides, Alder, Ann. and Mag. Nat. Hist., 1863. In part.
Botrylloides, Giard, Recherches, &c., 1872. In part.
Botrylloides, Della Valle, Contribuzioni, &c., 1877. In part.
Botrylloides, von Drasche, Synascidien, &c., 1883, p. 15.

Colony thin, incrusting, and usually gelatinous.
Systems elliptical, or elongated, forming branched and sometimes anastomosing lines.
Ascidiozooids cylindrical, with the apertures placed near one another on the anterior end.
Test soft and gelatinous, never much thickened, penetrated by many vessels.
Branchial Sac long and well developed.
Alimentary Canal placed alongside the branchial sac at its posterior end.
Reproductive Organs placed on both sides of the body near the posterior end.

This genus is distinguished from *Botryllus* and from *Polycyclus* by the shape of the systems, which may be of any form so long as they are not regular and circular; and from *Sarcobotrylloides* and *Polycyclus* by the colony forming a thin crust and not a solid mass. In this restricted sense *Botrylloides* has been used by von Drasche, while all other writers since Milne-Edwards (1842) include in it forms with a thickened test and massive colonies (*Sarcobotrylloides*, von Drasche).

Savigny, as Giard has pointed out, really indicated this genus in 1816 by dividing his species of *Botryllus* into sections, of which his first tribe corresponds exactly to Milne-Edwards' *Botrylloides*. No one, however, seems to have considered the group of species worthy of generic rank until Milne-Edwards in 1842 founded the genus *Botrylloides* for Savigny's first tribe of *Botrylli* and some new species which he described and figured in his great work on the Compound Ascidians of the English Channel. Since then many new species have been described, chiefly by Alder, Giard, and Della Valle.

I have adopted von Drasche's separation of the thin incrusting forms from those producing thick masses (*Sarcobotrylloides*), as it is certainly a convenient distinction and one which deserves to be recognised as much as does the similar character distinguishing *Botryllus* from *Polycyclus*.

The systems of *Botrylloides* are usually very irregular, but have a characteristic appearance (see Fig. 8, D and E, p. 39, and Pl. I. Figs. 1, 4). They are formed generally of several lines extending in different directions from a common cloaca, and in some cases branching and anastomosing. The Ascidiozooids border these lines, and are therefore placed in more or less parallel double rows. The following diagrams (Fig. 8)

show how a complicated system might be produced by a series of gradual changes from the simple stellate system of a *Botryllus*. They are all forms which are frequently seen in examining a number of colonies of different ages of a common *Botrylloides* (*e.g.*, *Botrylloides rubrum*, Milne-Edwards).

A shows a system like that characteristic of *Botryllus* and *Polycyclus*, composed of a few Ascidiozooids arranged radially around a circular common cloaca, so as to produce

FIG. 8.—Diagrams showing how a simple circular system (A) may develop through (B) and (C) into the condition characteristic of the systems in the genus *Botrylloides*, such as (D) and (E).

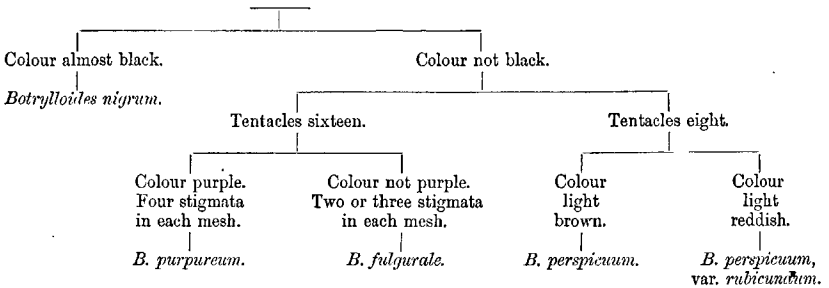
a stellate figure. In B the system has become elongated, the Ascidiozooids are more numerous, and the common cloaca is elliptical. This condition may sometimes be seen in species of *Botryllus*, and it is common in young colonies of *Botrylloides*. In C the system has become much larger and the number of Ascidiozooids is greatly increased. Each end of the formerly elliptical system has become enlarged, and one of them is commencing to fork or divide into two branches. D shows a still larger and

more complicated system, where the branches at the right hand end have increased considerably and are beginning to fork in their turn. In E, finally, an anastomosis has been effected between two of the secondary branches at the right hand side of the system so as to produce an island of common test (x, y) surrounded by a ring of Ascidiozooids. Such an island (which is very commonly seen in large colonies of *Botrylloides*, see Pl. I. fig. 4) is entirely different from a simple system such as A or B, not only in mode of formation but also in structure. In the first place it contains no common cloaca, and in the second place the surrounding Ascidiozooids are placed so that their ventral edges face inwards, while in the simple system (A or B) the dorsal edges of the Ascidiozooids are nearest to the centre of the space. This arrangement is obviously a result of the mode of formation of the "island," which is morphologically outside the system although enclosed by a part of it. It is, therefore, not at all surprising to find that such islands usually contain numbers of "terminal knobs" like those found in the colonial test outside the systems and forming the edges of the colony (see Pl. I. figs. 2, 5). Even more complicated conditions than that shown in E are found in old colonies of *Botrylloides*, but they are all produced in the manner which has been indicated by irregular branching and anastomosing.

The other characters by which the typical *Botrylloides* differs from the typical *Botryllus*, viz., the shape of the Ascidiozooid, its position in the test, and the situation of its apertures, may, I think be regarded as the natural result of the modification of the system which has just been traced. In *Botryllus* each Ascidiozooid in the system has its atrial aperture opening directly into the circular centrally placed common cloacal aperture, and therefore the body must be placed with its long axis directed radially, and the atrial aperture must be situated at the central (morphologically posterior and dorsal) end, far from the branchial aperture, in order that it may reach to the common cloaca. Hence in *Botryllus* the Ascidiozooids lie with their ovate bodies horizontal (*i.e.*, the antero-posterior axis is parallel with the upper surface of the colony), and the apertures are distant. Now when the system became much elongated it would clearly be impossible for the Ascidiozooids at a distance from the common cloaca to have their atrial apertures opening directly into that cavity, so they came to communicate with canals continued outwards through the test, from the common cloaca, one in each branch of the system. Such an arrangement would not only do away with any necessity for radial extension in the body of the Ascidiozooid, but would, by bringing the common cloaca (in the shape of its prolongation the canal) closer to the body, tend to cause the branchial and atrial apertures to come nearer. As a result of this we find in *Botrylloides* the cylindrical Ascidiozooids placed more or less vertically (*i.e.*, with the antero-posterior axis perpendicular to the surface of the colony), and with the apertures close together at the anterior end of the body.

In the collections there are four species and a well-marked variety of *Botrylloides;*

they are all new to science. One of the species was obtained during the "Lightning" expedition of 1868, the others are all Challenger specimens. The following scheme gives, in brief, the distinguishing characters of these new forms.



The specimen which is described under the name of *Botrylloides fulgurale* was obtained during the "Lightning" expedition of 1868, from a depth of 530 fathoms. This is probably the greatest depth at which a *Botrylloides* has been found.

Botrylloides purpureum, n. sp. (Pl. I. figs. 1, 2, and 3; and Pl. II. figs. 1–11).

The Colony is irregular in shape, large and spreading, and of moderate thickness. The surface is rather uneven, but smooth. The colour is a dark purple. A lighter area is found around the anterior ends of the Ascidiozooids and at the edges of the colony, which in some places become colourless and transparent. The common cloacal apertures are fairly numerous and conspicuous.

The length of the colony is about 7·5 cm., the breadth about 6 cm., and the average thickness about 2 mm.

The Ascidiozooids are elongated antero-posteriorly, being about 2 mm. in length and rather less than 1 mm. in greatest breadth. The anterior end, which is visible on the surface of the colony as a circular rather light coloured area, is about 1 mm. in diameter.

The Test is soft but firm. In no part does it become thick. On its thin expanded edges, at the margins of the colony, it is transparent and colourless or of a pale grey hue, elsewhere it is light purple. The terminal knobs of the vessels are not very conspicuous. They are of moderate size and of a dark purple colour. In sections the test is seen to be formed of a homogeneous matrix in which numerous minute rounded and fusiform cells are scattered. It is penetrated in all directions by numerous ramifying and anastomosing vessels with swollen terminations.

The Mantle is thin, but moderately muscular. It is very transparent. The muscle bands are very narrow, and run most of them in a transverse direction.

The Branchial Sac is of considerable size and fairly strong. The transverse vessels are narrow and all of one size. The internal longitudinal bars are of moderate strength. They are rather irregular in their course. The meshes are slightly elongated transversely, and contain each about four stigmata.

The Endostyle is narrow, but is conspicuous through the mantle. It is long and straight.

The Dorsal Lamina is a plain membrane with neither marginal teeth nor transverse ribs. It is usually, however, somewhat corrugated or crimped at its margin.

The Tentacles are sixteen in number. Four are very long and meet in the centre of the branchial aperture when laid flat. Four others alternating with these are about half as long, while the remaining eight are very short.

The Dorsal Tubercle is a small aperture with prominent edges placed a short distance in front of the anterior end of the dorsal lamina. There is usually no well-marked peritubercular area.

Locality.—Station 208, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud.

Only one specimen of this large and handsome species was obtained. It occurs growing over a very irregularly shaped mass of sponge trawled from 18 fathoms, at Station 208, near the Philippine Islands. The colour is a striking feature (Pl. I. fig. 1), and is probably not very different from what it was when living. The darkest areas are those which lie between the rows of branchial apertures and are formed by the posterior parts of the Ascidiozooids. The anterior ends are decidedly lighter coloured (Pl. I. figs. 2, 3), and show the circular open branchial apertures clearly. Under a lens or low power objective they also show the anterior extremity of the endostyle (Pl. I. fig. 3), the peripharyngeal band, the nerve ganglion, and an inner circle, which seems to be the line of insertion of the sixteen tentacles, having four marks, placed, one dorsally, one ventrally, and two laterally—these are probably the bases of the four largest tentacles. Further from the branchial aperture may be noticed three short radially directed lines upon each side; these are probably the anterior extremities of the internal longitudinal bars of the branchial sac. Over the whole of this anterior end of the Ascidiozooid little clumps of pigmented blood-corpuscles may be found scattered irregularly. From this description of the figure (Pl. I. fig. 3) it is obvious that a considerable amount of the anatomy of the Ascidiozooid may be made out simply from a surface view slightly enlarged. This is very rarely the case with alcoholic specimens of Compound Ascidians.

In some parts of the colony the Ascidiozooids are arranged in small nearly circular or elliptical systems, which suggest the arrangement in the genus *Botryllus*, but in other

parts of the colony (Pl. I. figs. 1, 2) the systems are large, irregular, and ramifying, as is usually the case in *Botrylloides*. The elongated shape of the Ascidiozooid (Pl. II. fig. 7), so characteristic of *Botrylloides*, places the matter beyond all doubt.

The terminal knobs of the vessels in the test, which sometimes form so conspicuous a feature in the external appearance of the colony in the Botryllidæ, are in the present species small and only visible on close inspection. They are of a dark purple colour, and only show clearly on the thin expanded edges of the colony, where the test is transparent. In such places they are fairly numerous (Pl. I. figs. 1, 2). The common cloacal apertures, which are widely open, are of irregularly elliptical shape, and of a very dark purple colour. The common test attains no great thickness in any part of the colony. At its thickest place it is scarcely 4 mm., twice the ordinary thickness of the colony. In some places the colony is much thinner than 2 mm., and on certain parts of the edges becomes merely a delicate expanded membrane formed entirely by the test.

In its minute structure this is simply a typical Botryllid test. The soft homogeneous matrix is seen in sections (Pl. II. fig. 1) to contain numbers of small dots, which under a higher power (see Pl. II. fig. 2, *t.c.*) are seen to be cells, all much of the same size but varying considerably in shape, the commonest forms being circular, ovate, fusiform, and triangular. Vessels are abundant, but of rather small size. They branch and anastomose freely, and frequently present dilatations upon their course or expand into terminal knobs often of irregular shape (Pl. II. fig. 1, *t.k.*), though usually more or less ovate. These knobs invariably contain blood-corpuscles, which are also commonly found in the vessels (Pl. II. fig. 2).

The piece of mantle which is figured (Pl. II. fig. 3) shows the mainly transverse direction in which the thin muscle bands run, and their characteristic method of dividing and joining with branches from adjacent bands. Each band is composed of at most a very few muscle fibres, frequently of one only, and these fibres show very clearly their origin from fusiform cells, which have become greatly elongated. The nucleus of the cell is in most cases still visible in a spindle-shaped swelling near the middle of the fibre. The rest of the mantle is formed of connective tissue, a clear homogeneous matrix, containing numerous scattered corpuscles of various shapes, and penetrated by lacunæ in which blood-corpuscles lie. In the figure (Pl. II. fig. 3) the fusiform nucleated swellings on the muscle fibres, the connective tissue cells, and the blood-corpuscles are represented.

The body of the Ascidiozooid (see Pl. II. fig. 7) is considerably elongated even for a *Botrylloides*. It is about two and a half times as long as it is broad. The mantle is slightly six-lobed at the branchial aperture, and is sufficiently transparent to show clearly the endostyle (Pl. II. fig. 7 *en*), the entire alimentary canal (*œ*, *st*, *i*, and *r*), the reproductive organs (*g*), and in some places the stigmata of the branchial sac.

The branchial sphincter is feebly developed. In the branchial sac a notable feature is the slight calibre of the transverse vessels (Pl. II. figs. 4 and 5, *tr*). In most places they

are no larger than the fine longitudinal vessels. The stigmata are a little irregular in form and by no means very large. The cells bearing the cilia (Pl. II. fig. 5, *sg. c.*) are cubical or short columnar in form and distinctly nucleated.

The endostyle, though narrow, is very conspicuous. Its edges are prominent, and at the anterior end are seen distinctly (Pl. II. fig. 6) to become continuous with the peripharyngeal band. At each side of the endostyle there is a widish area (about the size of a small mesh) of the branchial sac free from stigmata.

The dorsal lamina commences anteriorly as an extremely narrow membrane which rapidly widens (Pl. II. fig. 8, *d.l*). In some cases it appears to have transversely directed ribs or bands, but a careful examination always shows that they are merely corrugations or folds. The peripharyngeal band connecting the anterior ends of the endostyle and dorsal lamina circumscribes an oval area (Pl. II. fig. 8), inside which lies the circle of sixteen tentacles. The four largest tentacles are placed dorsally, ventrally, and laterally. There is no well-marked peritubercular area, and the dorsal tubercle, which is very simple, appears to vary somewhat in its position, size, and shape. Figure 8 shows a case where the tubercle is circular, very small, and placed close to the dorsal lamina, leaving a wide expanse of prebranchial zone between itself and the dorsal tentacle. In the specimen represented by figure 9 the tubercle was somewhat ovate in form with a slight constriction in the middle; it was also of larger size, and was placed about one third of the way from the dorsal lamina to the dorsal tentacle. In this last figure (Pl. II. fig. 9) the specimen is represented as seen from the outer surface (*i.e.*, from the mantle), and therefore the dorsal lamina is hidden by the nerve ganglion and neural gland (*n.g.*). The duct (*gl.d.*) leading from the dorsal tubercle to the neural gland is well seen.

The alimentary and reproductive viscera lie alongside the posterior third or so of the branchial sac (Pl. II. fig. 7). The œsophagus is rather long, and is abruptly curved in the middle of its course. It runs at first posteriorly and dorsally and then ventrally, and a little posteriorly. The stomach (*st*) is the most posterior part of the canal. It is large, equally wide at both ends, and strongly ribbed longitudinally. The intestine (*i*) runs at first ventrally, then anteriorly, then dorsally, and a little ventrally towards the œsophagus. It then curves anteriorly to become the rectum (*r*), which runs anteriorly and terminates in a wide anal aperture, about half way down the body. The course of the intestine is, as a whole, transverse and parallel to the stomach, and it therefore forms a right angle with the rectum, which runs antero-posteriorly.

The genital gland (*g*) is situated in front of the intestine, not far from the ventral edge. It is an irregularly lobed (Pl. II. fig. 10) opaque mass. The other genital gland is placed on the inner face of the mantle in the corresponding position on the other side of the body.

Figure 11 shows a young Ascidiozooid, many of which are found in various stages of development lying in the test alongside the older Ascidiozooids from which they have

budded. It is seen from the dorsal edge, and shows the mantle (*m*), the branchial sac, the prebranchial area in front bounded by the peripharyngeal bands, the œsophagus, stomach (*st*) and intestine, and the two genital glands (*o*), which in these buds are always filled with ova of various sizes, some of them apparently mature or almost so. The genital glands in the adult Ascidiozooid, on the contrary, show no ova, and appear to be merely testes. It is pretty certain, therefore, that protogyny occurs here as in many other Compound Ascidians, and that each Ascidiozooid produces ova in its genital gland when young, and spermatozoa only when fully developed. In this way cross fertilisation is effected, the ova of the younger members of the colony being fertilised by the spermatozoa of the older ones.

Botrylloides perspicuum, n. sp. (Pl. I. figs. 4, 5; and Pl. III. figs. 9–14).

The Colony is lobed, but not very irregular in form; it is rather thick. The surface is slightly uneven, but smooth. The general colour is a light brown, with a greyish-blue tinge in places. The anterior ends of the Ascidiozooids are light grey, but opaque. The edges of the colony, composed of test only, are a transparent grey, while the bodies of the Ascidiozooids cause the remainder of the colony to appear of a grey-brown colour with a slight tinge of purple. The common cloacal apertures are fairly numerous and conspicuous.

The length of the larger colony is 4 cm., the greatest breadth 3 cm., and the average thickness about 4 mm.

The Ascidiozooids are elongated antero-posteriorly and placed at right angles to the upper surface of the colony. Each is about 2 mm. in length and less than 1 mm. in its greatest breadth. The light coloured anterior end visible on the surface is about 0·5 mm. in diameter.

The Test is firm and in some places rather thick. At the margins of the colony, where free from Ascidiozooids, it is transparent, and almost colourless or of a pale grey hue. Elsewhere it seems of a pale bluish-purple colour. The terminal knobs of the vessels are very conspicuous in most parts of the colony. They are numerous and of a purplish-brown colour. In some places, however, especially along the edges of the colony, they are of a light grey colour. The matrix of the test is homogeneous and compact; it contains the usual small ovate and fusiform cells. Vessels are numerous and branch freely, especially near the surface and edges of the colony. The swollen terminations are very large, and usually more or less spherical in form; they contain many pigmented corpuscles of a brownish-purple colour.

The Mantle is thin and very slightly muscular. It contains a number of large pigmented cells scattered through it.

The Branchial Sac is large. The transverse vessels are of moderate breadth and all

of the same size. Usually there are three internal longitudinal bars on each side. The stigmata are of moderate size and regularly placed; there are usually three in a mesh.

The Dorsal Lamina is a plain membrane.

The Tentacles are eight in number, four long and four short, placed alternately.

The Dorsal Tubercle is a small ovate aperture with prominent edges placed in the middle of the dorsal part of the prebranchial zone. There is a shallow peritubercular area.

Locality.—Station 212, January 30, 1875; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms; bottom, sand.

Two colonies of this species were obtained near the Philippine Islands from a depth of 10 fathoms. The dimensions of the larger colony are given in the above description. Those of the smaller one are:—length about 3 cm., breadth about 2·5 cm., thickness 1 to 3 mm.

The colour varies considerably in different parts of the colony (see Pl. I. fig. 4). The free edges formed by test only are a transparent light grey marked with more opaque ashy grey spots where the terminal knobs of the vessels are present. The anterior ends of the Ascidiozooids are almost white, but quite opaque. The circular, open, branchial apertures are clearly visible to the eye. The remainder of the colony is darker, and is in some places of a purplish-brown colour, while in others it has a slight bluish tinge. The colour is due to the pigmented cells in the mantle around the lower parts of the Ascidiozooids, and in the swollen ends of the vessels in the test.

The colonies of this species are of such very considerable thickness[1] (see Pl. I. fig. 4) that at first glance they are liable to be taken for a *Sarcobotrylloides*, but, on cutting into the colony, it is found that it is not a solid mass, but merely a comparatively thin layer incrusting a core formed of sand-grains, shell fragments, and Annelid tubes.

The Ascidiozooids, in their arrangement, form the long winding rows characteristic of *Botrylloides*, and these rows, in some parts of the colony, bound comparatively large (such as 7 mm. by 5 mm.) elliptical or quadrate spaces free from Ascidiozooids and formed of test richly provided in its surface layer with brown-coloured terminal knobs of vessels. A similar arrangement is found in colonies of *Botrylloides gascoi*, Della Valle, from the Bay of Naples. The last species, however, differs entirely in colour and other particulars from the one under consideration.

Under a strong lens or a low power of the microscope (1 inch) the anterior part of the endostyle, the peripharyngeal band and the nervous mass are readily seen around the open branchial apertures. The terminal knobs of the vessels also form a conspicuous feature in such a surface view of the colony. They surround the Ascidiozooids on all sides (Pl. I. fig. 5), and give the colony a variegated appearance on account of some

[1] The measurements of the thickness given in the description are not the total thickness of the mass, including the sand and other foreign bodies, but merely the distance from the upper to the lower surface of the test as seen in a vertical section.

of them containing more pigmented corpuscles than others. The common cloacal apertures are usually slightly stellate or lobed in form when not opened to the full extent. Their membranous edges are richly provided with purplish-brown pigment corpuscles (Pl. I. fig. 5).

The cells of the test are small and inconspicuous. The matrix though generally homogeneous is in some places finely fibrillated. The vessels form a very prominent feature (see Pl. III. figs. 9, 10) with their numerous branches and large globular terminal knobs. The pigment corpuscles are large, circular, ovate, or elliptical in shape, and contain (Pl. III. fig. 12) fine reddish-brown pigment particles which are frequently placed entirely, or almost entirely, in one half of the cell.

The mantle, although it appears very thin and slight, contains many muscle bands, but they are very fine. The large pigmented cells form almost a continuous layer in some parts of the mantle and agree exactly in structure with those found in the vessels of the test (Pl. III. fig. 12). They are particularly well seen in sections stained in aniline blue, where the red-brown cells stand out well against the blue ground formed by the remainder of the mantle.

The branchial sac (Pl. III. fig. 11) is long and narrow, and is of a brown colour, due to the pigmented corpuscles. The transverse vessels are considerably broader than in the last species (*Botrylloides purpureum*), and contain muscle fibres. In one young specimen examined there were three internal longitudinal bars on the one side of the sac and four on the other. This specimen had fourteen rows of stigmata on each side, that is, there were thirteen transverse vessels. Another specimen, fully developed, but young, showed thirteen rows of stigmata on a side. There are usually ten to twelve stigmata in a row about the middle of the sac.

The endostyle is narrow and not very prominent. Its groove is deep and the columnar cells are fairly long. As usual, a series of very long cilia projects from the centre of the groove (see Pl. III. fig. 13). The dorsal tubercle is placed rather further forward than is usual. Directly behind it lies a large elliptical opaque yellowish-brown mass, formed by the nerve ganglion and the neural gland. In some specimens the smaller tentacles are absent, so that the number is reduced to four; while in others, although eight are present, they are all very short.

The alimentary canal is confined to the posterior region of the Ascidiozooid. The œsophagus runs posteriorly and ventrally and is moderately long (Pl. III. fig. 14, *œ*). It has no marked angle. The stomach is large and is strongly ribbed externally, especially at the œsophageal end, which is truncated and much wider than the opposite end where the stomach tapers somewhat suddenly into the intestine. There are usually five projecting folds on each side of the stomach. The intestine (Pl. III. fig. 14, *i*) curves anteriorly, and then dorsally, and a little posteriorly to touch the anterior edge of the stomach. It then turns dorsally and anteriorly to become the rectum, which, after

a very short course, ends not far in front of the œsophageal aperture. The anus has a slightly thickened band on the margin, but is not lobed or fringed in any way. In some specimens the intestine is wider than is shown in the figure (Pl. III. fig. 14), and is then evidently dilated by its contents.

Botrylloides perspicuum, var. *rubicundum*, nov. (Pl. I. figs. 6, 7 ; Pl. III. figs. 15–18).

The Colony is small, rounded or ovate, slightly lobed and moderately thick. The surface is somewhat uneven, but smooth. The general colour is a light reddish-purple in the centre, and white or grey round the edge. The anterior ends of the Ascidiozooids are slightly lighter. The common cloacal apertures are inconspicuous.

The length is 1·5 cm., the breadth 1 cm., and the average thickness about 3 mm.

The Ascidiozooids are elongated antero-posteriorly and placed at right angles to the surface of the colony. Each is about 2 mm. in length and about 0·7 mm. in greatest breadth. The anterior end is about 0·5 mm. in diameter.

The Test is firm, but soft. At the margins of the colony it is nearly transparent and usually of a light grey colour. In some places it is almost white. Elsewhere it is coloured by the Ascidiozooids. The terminal knobs of the vessels are in some places yellow and conspicuous. In other parts they are of a greyish colour like the test or slightly more opaque. The matrix of the test is homogeneous and very transparent in sections. The test cells are very minute and inconspicuous ; vessels are numerous and branch freely, especially near the surface and edges of the colony. The terminal knobs are large and more or less globular or ovate in form. They contain many corpuscles, some of which are coloured with a pale yellow pigment.

The Mantle is extremely thin and delicate.

The Branchial Sac is large. The transverse vessels are all of the same width. There are three internal longitudinal bars on each side. The stigmata are regularly placed, there are two or three in each mesh.

The Dorsal Lamina is a plain membrane.

The Tentacles are eight in number, four long and four short, placed alternately.

The Dorsal Tubercle is a small ovate aperture with prominent edges placed in the middle of the dorsal part of the prebranchial zone.

Locality.—Station 212, January 30, 1875 ; lat. 6° 54′ N., long. 122° 18′ E. ; depth, 10 fathoms ; bottom, sand.

The above description refers to half a dozen small colonies growing over lumps of sand, Annelid tubes, shell fragments, &c., dredged near the Philippine Islands, from a depth of 10 fathoms.

Several of the colonies are about the size given above ; the smallest is 5 mm. in length and 3 mm. in breadth.

The colour of the part of the colony where Ascidiozooids are present is pretty uniformly of a reddish-purple (Pl. I. figs. 6, 7), while the edges where the test is free from Ascidiozooids is greyish, marked in places either with yellow dots, or opaque grey dots. The anterior ends of the Ascidiozooids, although lighter than the rest of the body, are not nearly so light as in *Botrylloides perspicuum*. From all this it is obvious that the present specimens differ considerably from *Botrylloides perspicuum* in external appearance (compare Pl. I. fig. 4 with Pl. I. figs. 6, 7), but on account of the great similarity in their internal structure I have placed them under the latter species as a variety, until the examination of additional specimens of both forms gives us a more complete knowledge of the range of individual variation, and of the exact colouring of the colonies in the living condition.

Although the colonies of the variety are all of small size, still one can see from the arrangement of the Ascidiozooids in the systems that it is a *Botrylloides*. The lines, however, are not so long and winding as in *Botrylloides purpureum*, and no large spaces are enclosed by them as in *Botrylloides perspicuum* and *Botrylloides gascoi*.

The cells of the test are very inconspicuous, and the matrix is homogeneous and transparent. The vessels are numerous but delicate. Their terminal knobs, which are found chiefly close to the surface, vary greatly in form and size (Pl. III. fig. 18, *t.k.*). They are sometimes globular, sometimes ovate, and sometimes of an elongated pyriform shape, and occasionally very irregular. The pigmented corpuscles are not so large as in *Botrylloides perspicuum*, and they are of a pale yellow colour. The mantle is only slightly pigmented. In some cases it is scarcely coloured at all.

The branchial sac (Pl. III. fig. 15) is very like that of *Botrylloides perspicuum*. It is large and has many rows of regularly placed stigmata. There are usually four or five stigmata between the endostyle and the most ventral of the internal longitudinal bars. The endostyle is narrow.

The dorsal tubercle (Pl. III. fig. 16, *d.t.*) is exactly like that of *Botrylloides perspicuum*, and occupies a position unusually far from the dorsal lamina.

The alimentary canal (Pl. III. fig. 17) occupies only the posterior part of the Ascidiozooid. The œsophagus runs posteriorly and ventrally, and is moderately long. The angle varies somewhat in different individuals (compare figs. 14 and 17 in Pl. III.). The stomach is large and is strongly ribbed externally, especially at the œsophageal end, which is truncated and wider than the opposite end which tapers suddenly into the intestine (Pl. III. fig. 17, *i*). There are usually five projecting folds on each side of the stomach. The intestine curves anteriorly and then dorsally and a little posteriorly to come in contact with, and in some cases (Pl. III. fig. 17) considerably overlap, the anterior edge of the stomach. It then turns dorsally and anteriorly to become the rectum, which after a very short course ends not far in front of the œsophageal aperture.

Botrylloides nigrum, n. sp. (Pl. I. fig. 8; Pl. III. figs. 19–21).

The Colony is of irregular shape, flat, and spreading. The surface is uneven and moderately smooth. The colour is almost black except at the edge of the colony, where it is a little lighter. The common cloacal apertures are rather inconspicuous.

The length of the colony is about 7 cm., the breadth about 1·5 cm., and the average thickness about 2 mm.

The Ascidiozooids are elongated antero-posteriorly, being about 1·5 mm. in length and about 0·5 mm. in breadth. In thin parts of the colony their anterior parts show on the surface as dark areas less than 1 mm. in greatest diameter.

The Test is soft even in its thickest parts. On its thin expanded edges it is of a greyish colour and semi-transparent, elsewhere it is dark and opaque. The terminal knobs of the vessels are conspicuous in the thin marginal portions of the test as black, ovate or elongated markings. The test has a gelatinous homogeneous matrix in which numerous very minute cells are scattered thickly. Vessels are abundant and their swollen ends are very thickly placed close to the surface around the Ascidiozooids.

The Mantle is very thin and delicate. In some parts it is transparent, in others pigmented; the musculature is very slight.

The Branchial Sac is long and narrow. There are three internal longitudinal bars upon each side. The transverse vessels are rather narrow and are all of the same width. The meshes are nearly square, and contain each two or three stigmata.

The Dorsal Lamina is a plain membrane.

Locality.—Near the Island of Bermuda.

One large and a couple of small colonies of this species were obtained growing over Annelid tubes and Ascidians[1] from shallow water off Bermuda. The dimensions given in the above description are those of the large colony.

The dark colour is a striking feature (see Pl. I. fig. 8). In the thicker central parts of the colony it is almost black. In other parts it is of a dark earthy colour, while the expanded edges of the colonies are somewhat variegated, the greyish or opaque white test being marked with numerous black spots caused by the terminal knobs of the vessels. In the middle of the dark area formed by each Ascidiozooid is found, on close examination, a white spot, in the centre of which is seen the open circular branchial aperture.

Under a lens very little of the structure of the Ascidiozooid can be made out from the surface. The deeply pigmented mantle forms the dark area, which varies considerably in size and shape in the case of different Ascidiozooids. It is generally more

[1] Specimens of *Clavelina oblonga* (see Part I. of this Report, vol. vi. part xvii. p. 246).

or less elliptical or ovate, and a little less than 1 mm. in its greatest extent. The light mark surrounding the branchial aperture is caused by a band of opaque white pigment in the part of the mantle forming the branchial siphon. The anterior extremity of the endostyle is occasionally visible in the external view of the animal.

The Ascidiozooids are not always placed with their long axis perpendicular to the surface of the colony. In fact, in the thinner parts they always lie more or less flat, and there is considerable irregularity in their arrangement, the systems being difficult to trace, and recalling somewhat the arrangement in some groups of the Didemnidæ. The variegated or speckled appearance of the marginal regions of the colony free from Ascidiozooids is due partly to the presence of large numbers of vessels with their terminal knobs filled with black pigment corpuscles, and partly to a certain amount of opaque white pigment, both colours showing clearly against the semi-transparent grey of the test. In the greater part of its extent the large colony is thin, but in two or three places it has become considerably thickened, up to 4 mm. The smaller colonies are thin throughout; one measures 2 cm. in its greatest extent, and the other 6 mm.

The test is very soft and gelatinous. The matrix is perfectly transparent. The cells though minute are very numerous, and the vessels are abundant. Their terminal knobs are large, and the pigmented corpuscles which they contain are also large. The latter are ovate in shape and have the black pigment usually in one half only of the cell. They are exactly like the pigment cells of *Botryllioides perspicuum* (see p. 47 and Pl. III. fig. 12), except that the pigment granules in that case are brown. Besides these dark pigmented cells there are also in the terminal knobs a number of yellowish and of transparent corpuscles which are rather smaller but otherwise similar to the pigmented cells.

The mantle, where free from pigment, is perfectly transparent; but in the greater part of most Ascidiozooids pigment cells like those of the vessels in the test are very abundant, scattered through the connective tissue. Transverse muscle bands are present, but they are very delicate and quite colourless. The body of the Ascidiozooid when removed from the test is long and narrow, and the part occupied by the branchial sac is usually somewhat curved, with the concavity on the dorsal surface.

The transverse vessels of the branchial sac are narrow but have each a few muscle fibres (Pl. III. fig. 20, *tr.*). There are usually ten or twelve rows of stigmata in the branchial sac, and two or three stigmata in each mesh (Pl. III. fig. 19). The area lying between the endostyle and the most ventrally placed of the internal longitudinal bars has four or five stigmata. In some sacs the stigmata are short and wide (as shown in Pl. III. fig. 20). The endostyle is long and rather narrow, and is perfectly straight.

The alimentary canal forms a more rounded mass than usual. The œsophagus is wide and very short (Pl. III. fig. 21, *œ.*), and runs almost directly ventrally to open into the wide dorsal end of the stomach. The stomach is large, and has nearly the form of an

equilateral triangle in side view. The dorsal end is the widest part, and has five or six lobes upon each side. From the grooves between these lobes the channels, corresponding to the ridges on the inner surface, converge towards the narrow intestinal end. On the anterior surface of the stomach, about two-thirds of the way from the œsophagus to the intestine, there is a large ovate thick-walled cæcum (Pl. III. fig. 21, *cæ.*) into which the duct of a gland placed on the walls of the intestine opens. Beyond this cæcum the stomach tapers into the intestine, which turns anteriorly and dorsally, then a little posteriorly towards the œsophagus, and then finally curves sharply forward to become the short rectum. At its commencement the intestine is narrow, in its forward curve it widens, and then in its second or rectal bend it narrows again, and the rectum is the narrowest part of the alimentary canal (Pl. III. fig. 21).

The intestinal gland is composed of a number of clear tubules, which form a network over the last portion of the intestine. The duct springs from the posterior side of that region, and runs ventrally and posteriorly to open by a dilated end into the cæcum on the anterior wall of the stomach (see Pl. III. fig. 21). This system is the same as the so-called liver of many Tunicata, and the system in *Perophora* and *Salpa*, discussed by Chandelon,[1] and the refringent tubules described by Giard[2] in many Compound Ascidians, and the more posterior of the two glandular systems which I have figured in *Doliolum*.[3]

Many tailed larvæ occur in some parts of the colony. They have rounded or elliptical bodies about 0·42 mm. antero-posteriorly, and the tail measures about 0·8 mm. in length. In these larvæ there is only a single pigmented sense-organ present.

Botrylloides fulgurale, n. sp. (Pl. III. figs. 1–8).

The Colony is a large regular spreading mass of considerable thickness. The surface is uneven but smooth. The colour varies from buff to light brown, and has in places a slight pinkish tint. The anterior ends of the Ascidiozooids form lighter areas, and the edges of the colony are light grey. The common cloacal apertures are inconspicuous.

The extreme length of the colony is about 8·5 cm., the greatest breadth 4·5 cm., and the average thickness about 4 mm.

The Ascidiozooids are elongated antero-posteriorly, and are about 3 mm. in length and very nearly 1 mm. in greatest breadth. The light coloured area visible on the surface of the colony is rather less than 1 mm. in its greatest diameter.

The Test is rather hard, firm, and tough. It does not become excessively thickened in any part. There is very little expanded edge, the margins of the colony being comparatively thick and rounded, and of a greyish colour. The terminal knobs of the

[1] Sur une annexe, &c., *Bulletin de l'Acad. Roy. de Belgique*, t. xxxix., No. 6, 1875.

[2] Recherches sur les Synascidies, *Arch. de Zool. expér.*, t. i. p. 536.

[3] Report upon the Tunicata collected during the Cruise of H.M.S. "Triton," *Trans. Roy. Soc. Edin.*, vol. xxxii. pt. i. p. 93.

vessels are very inconspicuous. They are small and of a greyish colour, and are only abundant at the free edges. The test is formed of a homogeneous matrix in which small cells are scattered. These are not very numerous. In sections the vessels are fairly numerous, and their enlarged terminal knobs are abundant in the lower part of the colony and in the test lying between the Ascidiozooids.

The Mantle is moderately strong, and is very transparent. The muscle bands are narrow and are mostly transverse in direction.

The Branchial Sac is large, and the stigmata are numerous. There are three internal longitudinal bars on each side. The transverse vessels are moderately wide and not all of the same size. The meshes are square, and contain two or three stigmata each.

The Dorsal Lamina is perfectly plain.

The Tentacles are sixteen in number, eight long and eight short, placed alternately.

The Dorsal Tubercle is a circular opening with prominent edges placed about one-third of the way from the dorsal lamina to the tentacles. It is rather large. There is no peritubercular area.

Locality.—Station 12 of "Lightning" Expedition; lat. 59° 36′ N., long. 7° 20′ W.; bottom temperature, 6°·4 C.; depth, 530 fathoms.

One specimen[1] of this species was obtained during the cruise of H.M.S. "Lightning" in the summer of 1868 between Scotland and the Færöe Islands at Station 12,[2] depth, 530 fathoms. It is attached to a fragment of a large Lamellibranch shell, around which it has grown in such a manner as almost to cover the shell completely (Pl. III. fig. 1). The colour is pale and looks bleached, very possibly it was much brighter when living. The areas between the rows of Ascidiozooids are of a light brown colour, the edges of the colony where formed of test only are greyish, and the anterior ends of the Ascidiozooids are of a pale buff colour, and show clearly, when closely examined, the open circular branchial apertures.

Under a lens or low power objective the open branchial apertures are conspicuous objects, each surrounded by an opaque whitish region, the branchial siphon and sphincter (Pl. III. fig. 5, *sph.*). The anterior extremity of the endostyle is also clearly seen, and in some cases the peripharyngeal band and the nerve ganglion. The branchial aperture is frequently elliptical in shape, being elongated in a dorso-ventral direction (see Pl. III. fig. 5). Between the Ascidiozooids some of the vessels of the test can be made out, and occasionally terminal knobs are visible.

In one or two places the Ascidiozooids are arranged in small circular systems as in *Botryllus*, but over the greater part of the colony the systems are long and winding

[1] This specimen had been deposited along with some more of the "Lightning" material in the British Museum, and I am indebted to Dr. Günther for having placed the specimen at my disposal for description here along with the "Porcupine" and Challenger Compound Ascidians.

[2] Station 12 of the "Lightning," not the Challenger, series. For further particulars see Depths of the Sea, p. 81.

(see Pl. III. fig. 1). The vertical position and the shape of the Ascidiozooids are like those in a typical *Botrylloides*.

The test is of a pale buff colour in most of its extent. It is slightly lighter and more transparent on the margins. It attains no great thickness in any part, but forms an even layer over both surfaces of the incrusted shell. In vertical sections the vessels and their terminal knobs appear to be more abundant in the lower part of the test and between the Ascidiozooids than on the upper surface. This is rather a puzzling circumstance, and is apparently incapable of explanation according to my view[1] that these vessels and terminal knobs have a respiratory function. Possibly their curious arrangement in this species is due to the fact that there is comparatively little test on the upper surface of the colony, as the Ascidiozooids are numerous and closely placed, while on the surface at the posterior ends of the Ascidiozooids there is a thickish layer of test in which lie most of the vessels and their terminal knobs, and a number of buds and young Ascidiozooids. The terminal knobs are in some places, especially at the sides of the Ascidiozooids, exceedingly plentiful on the ends of the vessels, from which they bud off in all directions (see Pl. III. fig. 2). In some cases the terminal twigs are like small bunches of grapes.

The cells in the homogeneous test matrix are neither of large size nor very abundant. The turning in of the test to line the branchial siphon is very clearly seen both in a surface view and in vertical sections. Figure 5 on Plate III. shows the appearance presented in a surface view with Swift's 1-inch objective of a specimen stained in picro-carmine, from the outside. The dark band (*sph*) is the sphincter muscle, and the test is seen to form fifteen or sixteen lobes, where it turns in to line the aperture. In vertical sections these lobes can be traced down to the anterior edge of the tentacles (Pl. III. fig. 4).

The mantle is very like that of *Botrylloides purpureum*. The branchial sac is large, and is elongated at right angles to the surface of the colony. Some of the transverse vessels are wider than others, but there is no regularity in their arrangement. A few muscle fibres are generally to be seen in the transverse vessels. The internal longitudinal bars are strong (Pl. III. fig. 3, *i.l.*), and are slightly thickened at their points of union with the transverse vessels, but there are no papillæ. In a fully developed sac there are at least twelve rows of stigmata, and there are twelve to fourteen stigmata in the largest rows.

The endostyle is large and conspicuous (Pl. III. fig. 4, *en.*). The dorsal lamina is very distinctly ciliated along its free margin (Pl. III. fig. 8, *d.l.*). The tentacles (Pl. III. figs. 4 and 7, *tn.*) are regular in their alternating sizes and arrangement.

The dorsal tubercle is rather larger than usual (Pl. III. figs. 7, 8, *d.t.*). Its edges are formed of low columnar cells with cilia directed inwards towards the centre of the opening. In some specimens, as shown in the figure (Pl. III. fig. 7), the neural canal

[1] On a New Organ of Respiration in the Tunicata, *Proc. Lit. and Phil. Soc. Liverpool*, vol. xxxix. p. 39, 1884.

can be distinctly seen leading posteriorly from the dorsal tubercle to the opaque region at the anterior end of the dorsal lamina occupied by the ganglion and neural gland. The dorsal tubercle is unusually far from the peripharyngeal band (Pl. III. fig. 7). There is no peritubercular area, which is just what would be expected from the anterior position of the tubercle.

When cut in vertical section (see Pl. III. fig. 8) the opening of the tubercle is seen to lead into a wide ovate cavity lined by columnar epithelium provided with very long cilia bent downwards or from the opening. This cavity is continued in the form of a funnel into a narrow duct which leads to the neural gland placed upon the anterior surface of the nerve ganglion. The figure (Pl. III. fig. 8) shows a section from the prebranchial zone (*z.*) just behind the base of the tentacles to the dorsal lamina (*d.l.*). The epithelium of the prebranchial zone and of the dorsal lamina is cubical or low columnar and ciliated. There is a deep ciliated groove at the anterior end of the dorsal lamina and immediately behind the peripharyngeal band (*p.p.*). On the peripharyngeal band the epithelium becomes more columnar and the cilia rather longer, and it remains in the same condition on the edges of the opening of the dorsal tubercle. On the wall of the ovate cavity (*inf.*) the cells are still more columnar, and the cilia are extraordinarily long; they meet in the centre of the cavity, and then bend backwards so as to point towards the narrow duct behind. The walls of the duct are formed of cubical epithelium provided with short cilia. The gland is formed by short branched cæca which open into a space continuous with the lumen of the duct. In the figure they are seen cut at various angles; their walls are formed by cubical non-ciliated cells with distinct nuclei.

The nerve ganglion (*n.g.*) lies immediately posterior to the gland, and is very opaque. Nerve cells are seen over the outer surface. The connective tissue of the mantle in which the ganglion and neural gland lie is a clear homogeneous matrix with variously shaped connective tissue cells scattered through it. Rounded, fusiform and stellate forms are most abundant. Here and there in small sinuses are found blood-corpuscles, and a few muscle fibres (*m.f.*) extend upwards from the muscular part of the mantle further back.

The alimentary canal has much the same appearance and takes much the same course as in *Botrylloides perspicuum*. The œsophagus is long, and is curved with the convexity dorsal. The stomach is wide at the dorsal end and narrow at the ventral, where it passes gradually into the intestine. There are ten folds projecting into the interior of the stomach and visible as channels on the exterior, five on each side. The intestine curves anteriorly and then dorsally, and after running along the anterior edge of the stomach to the œsophagus it turns anteriorly again to become the short rectum. In some specimens the first portion of the intestine is much swollen with food.

There is an irregularly stellate (Pl. III. fig. 6) or lobed genital gland on each side of the posterior part of the branchial sac. In the fully developed Ascidiozooids this gland

is composed of testes only, while in young buds a series of ova, one or two of which appear mature, occupy the same region. This species, therefore, like some others, is protogynous (see p. 45).

Sarcobotrylloides, von Drasche.

Sarcobotrylloides, von Drasche, Die Synascidien der Bucht von Rovigno, Wien, 1883, p. 14 (as a subgenus).

Colony thick and fleshy, often lobed.

Systems elliptical, or elongated, forming branched and sometimes anastomosing lines.

Ascidiozooids cylindrical, with the apertures placed near one another on the anterior end.

Test gelatinous, rather solid and greatly thickened, many vessels present.

Branchial Sac large and well developed.

Tentacles eight to sixteen in number.

Alimentary Canal placed alongside the posterior part of the branchial sac.

Reproductive Organs placed on both sides of the body near the posterior end.

This genus was instituted by von Drasche in 1883 as a subgenus of *Botrylloides*, for the reception of a species bearing the same relation to other species of *Botrylloides* that *Polycyclus* does to *Botryllus*. As I have stated before (p. 38), I consider *Sarcobotrylloides* sufficiently well characterised to be raised to generic rank, and I am glad to be able to add a second species which is quite as distinct as *Sarcobotrylloides superbum*, von Drasche, from members of the allied genus *Botrylloides*.

Colonies of *Sarcobotrylloides* form thick solid masses, which may be irregularly lobed on the outside, or produced into processes.

The systems are precisely like those of the genus *Botrylloides*. The Ascidiozooids occupy only the outer parts of the colony, the centre being formed by a solid mass of test, penetrated by vessels which may have dilatations in which buds are produced. In shape and anatomy the Ascidiozooid is almost exactly like that of *Botrylloides*.

The new species described below was obtained during the cruise of H.M.S. "Porcupine" in 1869, half way between the Butt of Lewis and the Færöe Isles, at a depth of 363 fathoms, a very considerable depth for one of the Botryllidæ to inhabit. It differs from von Drasche's species (*Sarcobotrylloides superbum*), the only other known species of the genus, in many particulars. The colour of the colony as a whole, and of the several parts, is quite different in the two species; the test, for example, is opaque white in *Sarcobotrylloides superbum*, and of a pale pink or light purple colour in *Sarcobotrylloides wyvillii*. The common cloacal apertures are stated by von Drasche to be few but large, with projecting margins. In the "Porcupine" specimen none are visible, still this is

probably due in great part to the contracted condition of the colony, caused by preservation in alcohol. The Ascidiozooids are very much shorter antero-posteriorly in *Sarcobotrylloides wyvillii* than in *Sarcobotrylloides superbum*, and are less regularly arranged in systems (compare Pl. IV. fig. 12 with von Drasche's figure). There are only eight tentacles in *Sarcobotrylloides superbum*, while *Sarcobotrylloides wyvillii* has sixteen. This list of the more notable differences—there are others of less importance—shows clearly that these forms constitute two well-marked species.

I have named the new species *Sarcobotrylloides wyvillii* in honour of Sir Wyville Thomson, who dredged it in the "cold area" of the Færöe Channel[1] close to the famous "Wyville Thomson" ridge. This region has since been investigated by Mr. Murray and Captain Tizard in the "Knight Errant" (1880)[2] and the "Triton" (1882), but no Compound Ascidians were obtained during these expeditions.

Sarcobotrylloides wyvillii, n. sp. (Pl. IV. figs. 12–18).

The Colony is of an irregular elongated form and of considerable thickness. The surface is somewhat uneven, but smooth. The colour varies from pale pink to light purple. The anterior ends of the Ascidiozooids form lighter areas, and the basal part of the colony is light grey and semi-transparent. The common cloacal apertures are inconspicuous.

The length of the colony is 4·3 cm., the breadth is 1·6 cm., and the thickness is 1·3 cm.

The Ascidiozooids are elongated antero-posteriorly, being about 1·5 mm. in length, and rather less than 1 mm. in greatest breadth. The light area formed on the surface of the colony by the anterior end of the Ascidiozooid is about 0·5 mm. in diameter.

The Test is soft but moderately firm. It is very thick all over the colony. At the narrow base it is light coloured and semi-transparent, elsewhere, as seen from the surface, it is opaque and of a pale bluish-pink or very light purple colour. No terminal knobs of vessels are visible. The test is formed of a homogeneous transparent matrix, in which numerous rounded fusiform and stellate cells are imbedded. The vessels are fairly abundant, but rather narrow, and they do not branch much. The terminal knobs are not very abundant, except just under the surface.

The Mantle is thin but fairly muscular. The muscle bands are mostly transverse in direction, and are very delicate.

The Branchial Sac is of moderate size. There are three internal longitudinal bars on each side. The transverse vessels are moderately wide, and are all of the same size. stigmata are regular, and are usually about four in a mesh.

The Dorsal Lamina is a plain membrane.

[1] See Depths of the Sea, Third Cruise of the "Porcupine" in 1869, p. 104. London, 1873.

[2] See *Proc. Roy. Soc. Edin.*, vol. xi. p. 638, 1882.

The Tentacles are rather large. There are sixteen, eight long and eight shorter, placed alternately.

The Dorsal Tubercle is a simple rounded opening placed not far behind the base of the tentacles.

Locality.—Station 54 (of the third cruise of H.M.S. "Porcupine" in the summer of 1869); lat. 59° 56′ N., long. 6° 27′ W.; bottom temperature −0°·3 C. ("cold area" of Færöe Channel); depth, 363 fathoms.

Only one specimen referable to the genus *Sarcobotrylloides* is in the collection. It was dredged during the cruise of H.M.S. "Porcupine" in 1869, at Station 54, from a depth of 363 fathoms. It is an irregularly elongated mass (Pl. IV. fig. 12), which has grown over and partially buried a group of Hydroid Zoophytes composed of *Sertularia operculata*, *Diphasia rosacea*, and *Campanularia volubilis*. Ascidiozooids are visible and abundant on all surfaces of the mass except a small area at the narrow lower end of the colony, near where the Zoophytes were attached. On this area the colour is a light partially transparent grey, elsewhere it is a pale pinkish or faded purple, with here and there a tinge of blue. The small anterior ends of the Ascidiozooids are lighter than the rest, and seem at first sight to be scattered quite irregularly over the surface. In some places, however, systems or parts of systems can be made out. A few of these are circular or elliptical, the rest are elongated and very irregular (see Pl. IV. fig. 12).

A surface view of the colony under a low power of the microscope reveals the minute and rather inconspicuous branchial aperture of the Ascidiozooid surrounded by an opaque white band caused by the sphincter muscle. Outside that is seen, in some cases, the peripharyngeal band and the nerve ganglion, and almost invariably the anterior extremity of the endostyle. The branchial aperture, when not circular, is frequently elongated transversely. The darkest coloured part is the region lying around and between the branchial apertures, and this owes its slightly purple tint to the lower parts of the bodies of the Ascidiozooids showing through the grey test. Here and there very fine vessels can be seen ramifying near the surface, and in some parts of the colony buds and young Ascidiozooids of a pale colour are visible.

No common cloacal apertures can be satisfactorily made out either by the eye or in a low power surface view. This is doubtless due to the contracted condition of the specimen.

The test is very thick. In a section across the colony it is seen that the Ascidiozooids occupy only a layer extending for at most 2 mm. inwards from the surface, while the whole of the centre of the mass is composed of the grey semi-transparent softish test, in which, however, many vessels and young buds are imbedded (see below).

The cells in the test are abundant and fairly large. The vessels are rather peculiar. They are abundant, but are narrower than usual and branch comparatively little, the result being that they appear in the form of long straight or winding but usually

unbranched tubes. The swollen knobs are very abundant and large in some parts of the surface layer, where they are arranged like bunches of grapes. Deeper down in the test this arrangement is never found, and most of the knobs are not terminal but occur upon the course of the vessels (Pl. IV. fig. 13), or where several intersect. In the large knobs in the surface layer blood-corpuscles are very abundant, and the knobs are flattened out parallel with and close to the surface, and altogether look like a respiratory apparatus. Those in the deeper parts, however, below the Ascidiozooids, are comparatively rarely filled with blood-corpuscles, while most of them show variously shaped masses of cells, which are undoubtedly buds in different stages of development (see Pl. IV. fig. 13, *gm.* and *gm'.*). The youngest of these, placed in small enlargements on the vessels, contain each a few blood-corpuscles and a few large cells which very soon assume the unmistakable characters of ova. These latter increase in size and slightly in number, and form the most prominent feature in all sizes of buds. In the later stages (Pl. IV. fig. 13, *gm.*) the ova occupy one end of the bud, while the rest is formed of an opaque mass of cells derived apparently from the blood-corpuscles. The whole is closely invested by the wall of the swollen vessel, which is now of considerable size.

Savigny, in his description of the marginal tubes,[1] as he called the vessels of the test in the Botryllidæ, seems to have regarded them as an apparatus for the production of buds, and this view, which was more fully elaborated and established by Milne-Edwards,[2] was generally accepted until Metschnikoff[3] and Krohn[4] in 1869 stated that the previous investigators had been mistaken, and that gemmation took place from the sides of the bodies of the Ascidiozooids, and that the marginal tubes were merely blood-vessels. Since then the vessels seem almost universally to have been regarded as having nothing to do with gemmation. Ganin,[5] however, in 1870 and Giard in 1872[6] stated that in the Botryllidæ buds might be produced in the stolons or vessels as well as from the bodies of the Ascidiozooids.

About five years ago, while working out the anatomy and histology of the genus *Colella* (see below, p. 88), I was astonished to find that there was good reason to believe that in that Ascidian at least the vessels were most directly concerned in the production of new Ascidiozooids, and that, just as in the present species, the bud was formed of elements from three sources—the wall of the vessel, blood-corpuscles, and large cells which become ova. The wall of the vessel is formed of ectoderm lined by connective tissue from the mantle, the blood-corpuscles are mesoderm cells, and the ova according to E. van Beneden's researches[7] are derived from the mesoderm. This, however, does

[1] "Tubes marginaux" and "rameaux vasculaires," Mémoires, 1816, pp. 47 and 231, pl. xxi. fig. 1.
[2] Observations, &c., 1842.
[3] Ueber die Larven und Knospen von Botryllus, *Bull. Acad. Sci. St. Petersburg*, vol. xiii. p. 293.
[4] *Archiv f. Naturgesch.*, Jahrg. xxxv. Bd. i. pp. 190 and 326.
[5] Neue Thatsachen &c., *Zeitschr. f. wiss. Zool.*, t. xx. p. 512.
[6] Recherches sur les Synascidies, *Archives d. Zool. expér.*, t. i. p. 574.
[7] *Zool. Anzeiger*, 1881, No. 88, p. 375.

not explain the origin of the endoderm tissues of the resulting Ascidiozooid, and after a careful examination I am unable to find any other elements in the young bud besides those mentioned, and yet at an early stage an inner endodermal sac is formed which afterwards develops into the branchial sac and the remainder of the alimentary canal. This endoderm layer has no connection with the wall of the vessel, and is certainly not formed from the young ova, but it is, I am convinced, derived from the blood-corpuscles. These cells, which are still primitive and undifferentiated, are usually regarded as mesodermal, but E. van Beneden[1] has shown that in the Ascidian embryo the mesoblast is formed from the primitive endoderm as two laterally placed masses of cells, some of which become blood-corpuscles. It is possible that some of these (or their descendants) may retain their endodermal characters to such an extent that when they pass into a young bud as blood-corpuscles they are still able to act as endoderm cells and form the enteron of the future Ascidiozooid. If this view be correct, then the bud is formed by cells derived, as we should expect, from all three primary layers of the body of the parent. If, on the other hand, the blood-corpuscles cannot be regarded as contributing an endodermal element, then it is by no means obvious what the endoderm tissues of the bud are derived from.

The irregular arrangement of the Ascidiozooids in *Sarcobotrylloides wyvillii*, which is rather puzzling as seen from the surface, is not so striking when viewed from the interior after the upper layer of the colony has been dissected off. Then the systems can in most places be traced, and if the top layer of test be examined from its inner surface, the places where the Ascidiozooids were placed, and their arrangement in systems more or less like those which are usually found in *Botrylloides*, can be readily made out (Pl. IV. fig. 15). In the figure the central area is formed by a thin layer of test, and has no common cloacal aperture, while the irregularly rounded projections surrounding it are parts of the regions occupied by Ascidiozooids, and have each a somewhat thickened margin formed by the test, and in some cases an adhering lining of mantle.

The mantle is much like that of the genus *Botrylloides*, but is rather more muscular. The branchial sphincter is moderately strong.

The transverse vessels of the branchial sac are rather wide, and have each a few muscle fibres. The stigmata are large and regularly arranged (Pl. IV. fig. 14, *sg.*). The endostyle is wide and thick. The tentacles are larger than is usual in the genus *Botrylloides*.

The infundibulum leading from the aperture of the dorsal tubercle, and its continuation the neural duct, are unusually distinct. The funnel is proportionally rather longer than in *Botrylloides fulgurale* (Pl. III. fig. 8), but otherwise the relations are the same. The neural gland extends for some distance beyond the opaque ovate nerve ganglion posteriorly.

The stomach is large, and is strongly ribbed on the exterior. In the young

[1] Existe-t-il un Coelome chez les Ascidies? *Zool. Anzeiger*, 1881, No. 88, p. 375.

Ascidiozooids ova are present in two masses, one on each side of the body near the posterior end, but in the fully developed condition no ova are present, and the irregularly stellate genital gland is formed entirely of spermatic vesicles.

An extraordinarily large number of tailed larvæ are present in the colony. They appear to be all at the same advanced stage of development. Only one pigmented sense-organ is present; it is placed to the left of the middle line when the body is viewed from the dorsal surface. The shape of the body of the larva varies according to the point from which it is viewed. When seen from the side (Pl. IV. fig. 17) it is equally wide in front and behind, while the dorsal or the ventral aspect shows the posterior end much narrower than the anterior (Pl. IV. fig. 16). The urochord is very distinct, and is formed of a single series of large cubical cells (see Pl. IV. fig. 18).

Polycyclus, Lamarck.

Polycyclus, Lamarck, Mém. Mus. Hist. Nat. Paris, t. i., 1815.
Botryllus, Savigny, Mém. Anim. s. vert., pp. 47, 202, 1816. In part.
Polycyclus, Risso, Hist. Nat., &c., t. iv., Paris, 1826, p. 280.
Polycyclus, Lamarck, Hist. Nat. Anim. s. vert., vol. i. p. 575, 1837.
Polycyclus, Delle Chiaje, Descrizione e Notomia, &c., t. iii. p. 19, Nap., 1841 (as a subgenus).
Botryllus, Milne-Edwards, Observations, &c., 1842. In part.
Botryllus, Forbes and Hanley, British Mollusca, vol. i., London, 1853. In part.
Botryllus, Grube, Die Insel Lussin, &c., p. 64, Breslau, 1864. In part.
Botryllus, Giard, Recherches sur les Synascidies, p. 619, Paris, 1872. In part.
Polycyclus, Della Valle, Contribuzioni, &c., p. 22, Napoli, 1877 (as a subgenus).
Polycyclus, von Drasche, Die Synascidien der Bucht von Rovigno, p. 13, Wien, 1883 (as a subgenus).

Colony thick, fleshy, and often lobed.
Systems circular in outline.
Ascidiozooids ovate, with the apertures rather distant from one another.
Test gelatinous, but solid and much thickened, vessels present.
Branchial Sac large and well developed.
Tentacles from two to sixteen in number.
Alimentary Canal placed alongside the posterior end of the branchial sac.
Reproductive Organs placed on both sides of the body near the posterior end.

This genus, although founded as far back as 1815, has been by no means generally accepted by writers on the Tunicata, most of whom have included Lamarck's species in the genus *Botryllus*.

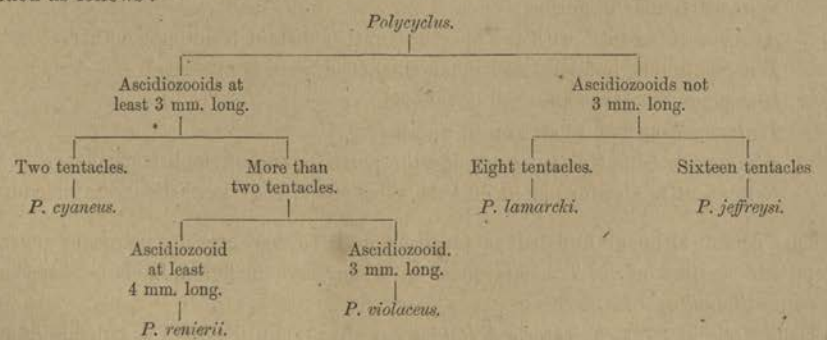
Della Valle in 1877 characterised *Polycyclus* afresh, and regarded it as being of equal rank with *Botrylloides*, both being subgenera. On the other hand, von Drasche considers *Botrylloides* as a distinct genus, and *Polycyclus* as merely a subgenus of *Botryllus*. I prefer, as explained before (p. 36), to regard these groups of species as being all of

equal rank, and I think it is simpler to call them all genera. Consequently I return to Lamarck's view, and consider *Polycyclus* as a distinct genus. It is characterised by the proportions of the colony, the shape of the systems, and the position of the apertures and form of the body in the Ascidiozooid.

The colony, like that of *Sarcobotrylloides*, is thick, forming a large and usually lobed mass in place of a thin crust as in *Botryllus* and *Botrylloides*. The systems are stellate, with circular outlines as in *Botryllus*, and thus differ from those of *Botrylloides* and *Sarcobotrylloides*. The Ascidiozooids of *Polycyclus* have the ovoid form with distant apertures, which is found in *Botryllus*. The possession of two laterally placed tooth-like tentacles is also given by von Drasche as a character of the genus, but as I do not find that feature in the new species described below, which are in all other respects typical members of the genus—I leave out this characteristic. In one of the new species the tentacles are eight in number, in the other sixteen, and in neither do two predominate over the others, consequently the tentacles of the genus must be regarded as varying from two to sixteen.

A number of species have been described which may be referred to this genus, but in the cases of the older of these it is very uncertain how far they are distinct from one another. Some of them are very imperfectly known.

Lamarck described *Polycyclus renierii*, and this is probably not the species described by Savigny as *Botryllus polycyclus*. Della Valle suggests that the *Polycyclus elongatus* of Delle Chiaje is simply a variety of *Polycyclus renierii*, a species which he describes in detail. Grube also discusses *Polycyclus renierii* and a slightly different form which he regards as a variety. Two new species, *Polycyclus cyaneus* and *Polycyclus violaceus*, were described by von Drasche in 1883. Leaving out the uncertain forms, the genus may be divided as follows :—



The two new species were both obtained during the "Porcupine" expeditions, *Polycyclus lamarcki* in the Færöe Channel from a depth of 363 fathoms, and *Polycyclus jeffreysi* from Tangier Bay in the Mediterranean, in shallow water.

Polycyclus lamarcki, n. sp. (Pl. IV. figs. 1–5).

The Colony forms a large rounded lobed mass of considerable thickness. The surface is fairly even, and is smooth. The colour is between buff and pale orange. A lighter coloured area is found in the centre of each system around the common cloacal aperture, and here and there are similar patches between the systems. The circular systems are fairly regular, but are very closely placed. The common cloacal apertures are large and conspicuous.

The length of the colony is 6 cm., the greatest breadth is 4 cm., and the average thickness about 1·5 cm.

The Ascidiozooids are elongated obliquely from the ventral part of the anterior end to the dorsal part of the posterior. On an average they are about 1·5 mm. in greatest length.

The Test is firmer than is usual in the Botryllidæ, and is greatly thickened all over the colony; where free from Ascidiozooids it is of a pale bluish-grey tint. The terminal knobs of the vessels are not conspicuous, as they are also of a greyish colour. The test is composed of a clear homogeneous matrix, in which numerous cells of various sizes and shapes are thickly scattered. The vessels are abundant and branch freely, their terminal knobs are numerous and large.

The Mantle is thin. The muscle fibres are very fine and appear to run irregularly, most of them are more or less transverse in direction.

The Branchial Sac is large and strong. The transverse vessels are rather narrow, and are all of the same size. There are three internal longitudinal bars upon each side. The meshes are about square, and contain each three stigmata. The fine longitudinal vessels are rather narrow, and the stigmata are of moderate size and regularly arranged.

The Dorsal Lamina is a plain but rather wide membrane, with its edge somewhat corrugated at the anterior end.

The Tentacles are rather short. There are only eight, and they are all of much the same length.

The Dorsal Tubercle is a very small and inconspicuous aperture placed near the anterior end of the dorsal lamina.

Locality.—Station 54 (of the cruise of H.M.S. "Porcupine" in 1869); lat. 59° 56′ N., long. 6° 27′ W.; bottom temperature —0·3° C.; depth, 363 fathoms.

This species is formed for a specimen of *Polycyclus* obtained during the cruise of H.M.S. "Porcupine" in 1869, at Station 54, in the Færöe Channel, from a depth of 363 fathoms. It is attached to and has partially grown over a colony of *Sertularia operculata*. It is irregularly lobed at the free end, and the lobes are all rounded, which gives the colony very much the appearance (Pl. IV. fig. 1) of a specimen of *Alcyonium digitatum*. The thickness is so considerable that there can be no doubt as to the propriety of separating this and similar forms from the genus *Botryllus*.

The general colour is a yellowish-brown. The Ascidiozooids, as seen on the surface, are

bright yellow, the cloacal apertures are whitish, and the surrounding area is grey, while the small intervals left here and there between the systems are of a bluish-grey tint.

The systems are very numerous, and are so closely placed over the whole colony that very little of the test is visible, and here and there it becomes a little difficult to determine where the different systems end. The systems are all nearly circular in form, and contain from eight to fourteen Ascidiozooids each; the general numbers are nine, ten, and eleven (see Pl. IV. fig. 1).

The part of the Ascidiozooid seen from the surface is of ovate form, with the narrower end pointing towards the common atrial aperture or centre of the system. It is on an average about 1·5 mm. long and 1 mm. broad, but in some places longer Ascidiozooids occur, measuring up to 2·5 mm. in length.

Under a low power of the microscope the branchial apertures, which are just visible to the unaided eye, are seen to be bounded by a rather wide opaque white band, the sphincter muscle, while a much narrower white line, the peripharyngeal band, is in most cases visible further out (compare Pl. IV. fig. 2). The anterior part of the endostyle and the nerve ganglion are also usually visible; no vessels are seen in this surface view. The common cloacal apertures are very clearly visible to the naked eye, all over the colony. They are all more or less widely open, and are bounded by distinct thickened whitish rims. They are circular or elliptical in shape, and vary in size from 0·5 mm. to 2 mm. in diameter (Pl. IV. fig. 1).

A section through the colony shows the great thickness of the test. The Ascidiozooids occupy merely a thin layer, of a yellowish colour, extending from 1 mm. to 1·5 mm. inwards from the surface; the rest of the thickness of the colony is formed of the soft grey semi-transparent test. At the lower end of the colony, near the point where the incrusted Zoophyte was attached, there is a small tapering portion of test free from Ascidiozooids. This is the only place where the terminal knobs of the vessels are visible in surface view. They are fairly numerous, but being small and of an opaque grey tint, they are by no means conspicuous. In the superficial layer of test over the colony generally, vessels are present, but they are small and their terminal knobs are of small size. This rather feeble development of vessels in the test of this species seems to be due simply to want of room in the superficial part owing to the large number of Ascidiozooids.

The mantle musculature is irregular and of fair strength. The atrial siphon is prolonged into a tube of considerable length and having a rounded termination (Pl. IV. fig. 3 *at.*). Its walls, which are simply a continuation of the mantle, are provided with both longitudinal and transverse muscle bands. The latter are more abundant and stronger than the former. The branchial aperture is very small, and the sphincter is fairly strong (Pl. IV. fig. 2, *sph.*).

The branchial sac seems stronger than is usual in the genus *Botrylloides*. In one sac examined there were ten rows of stigmata, but in some of the others there are probably

more. There are six or seven stigmata between the dorsal lamina and the first internal longitudinal bar (Pl. IV. fig. 3), and about the same number (in the middle of the sac) between the endostyle and the third bar, so that altogether there are about twenty stigmata in one of the longest rows of a fully developed sac. The stigmata are very regular, and are usually wider than the fine longitudinal vessels. They are often wider than is shown in the figure (Pl. IV. fig. 3, *sg.*). The endostyle is rather narrow.

The eight tentacles (Pl. IV. fig. 2, *tn.*) are usually all of the same length, but in some cases four of them are shorter, the long ones being the dorsal and ventral and the two median lateral tentacles. The latter pair are never larger than all the others, as they are in von Drasche's *Polycyclus violaceus*. The dorsal tubercle (Pl. IV. fig. 2, *d.t.*) is decidedly small and inconspicuous. It is placed much nearer to the dorsal lamina than to the tentacles. There is no well-marked peritubercular area. The figure formed by the peripharyngeal band is pyriform, with the narrower end ventral. The anterior extremity of the endostyle is further from the branchial aperture than the anterior end of the dorsal lamina is.

The alimentary canal is fairly compact, and lies alongside the posterior one-fourth or so of the branchial sac. The œsophagus runs posteriorly and ventrally with a slight curve. The stomach is not very large. It is ovate in shape, with the intestinal end widest. There are four or five projecting folds on each side. The intestine runs anteriorly and then turns dorsally, and, touching the anterior wall of the stomach in its whole course, reaches the œsophagus, where it turns anteriorly again and runs forwards as the rectum for a short distance along the dorsal edge of the branchial sac (Pl. IV. fig. 3, *r*). The anus opens into a considerable cloaca, the dorsal part of the peribranchial cavity, and this communicates with the common cloacal cavity of the system by the bulbous prolongation of the mantle already described (Pl. IV. fig. 3, *at.*). The anus is curiously shaped. The rectum narrows considerably at the top, to form a neck, above which the margin of the anus expands into a more or less flattened disk with an irregularly crenated margin. Figure 4 shows the top of the disk and the small puckered anal aperture as seen from above; figure 5 shows another specimen seen from the side and in optical section; while figure 3 represents in surface view, as seen from the side, an anus where the disk had only two marked crenations, thus giving it rather a bilabiate appearance.

The reproductive organs are, contrary to the rule in most of the Botryllidæ in the collection, hermaphrodite. They consist in the fully developed Ascidiozooid of one or two large yellow ova and an irregular group of spermatic vesicles. They are placed in the usual position on both sides of the body.

Polycyclus jeffreysi,[1] n. sp. (Pl. IV. figs. 6–11).

The Colony is a slightly irregular mass of moderate thickness, which has grown upwards from a narrow base. The surface is fairly even and very smooth. The colour is a light yellowish-grey on which slight brownish streaks indicate the Ascidiozooids. The base of the colony is more of a transparent grey, with numerous opaque white terminal knobs scattered over it. The circular systems are regular, and are not closely placed. The common cloacal apertures are in some places fairly conspicuous.

The length of the colony is 3 cm., the greatest breadth is 2 cm., and the average thickness about 8 mm.

The Ascidiozooids are elongated obliquely from the ventral edge of the anterior end to the dorsal edge of the posterior end, and the dorsal and anterior regions are nearest to the surface of the colony. On an average they are about 2 mm. in their greatest length.

The Test is soft inside but firm on the surface, and is considerably thickened except at the very base of the colony. Where free from Ascidiozooids it is grey and slightly transparent. At the base the terminal knobs of the vessels are very conspicuous. The test matrix is, in most places, clear and homogeneous. The cells are numerous and of various shapes. There are many irregularly stellate forms with long delicate branched rays. Vessels are not very abundant, and are rather small; their terminal knobs are large.

The Mantle is thin and membranous, and is remarkable on account of the almost total absence of muscle fibres.

The Branchial Sac is very large. There are three internal longitudinal bars upon each side. The transverse vessels are moderately wide, and are all of the same size. The meshes are elongated transversely, and each contains five or six stigmata. The fine longitudinal vessels are very narrow, while the stigmata are unusually wide. They are regularly arranged.

The Dorsal Lamina is a plain membrane. At the anterior end, which is narrow, it has a serpentine course, and its edge is usually undulating.

The Tentacles are moderately large. There are sixteen, eight long and eight short. The latter are very small, and usually irregular.

The Dorsal Tubercle is a small circular aperture placed very close to the dorsal lamina. There is no peritubercular area.

Locality.—Tangier Bay, Strait of Gibraltar, August 5, 1870; depth, 35 fathoms.

[1] Named after Dr. Gwyn Jeffreys, F.R.S., who was in charge of the "Porcupine" during the first cruise of the expedition in 1870 when this species was obtained.

The single specimen for which this species is formed was dredged in Tangier Bay on the Coast of Morocco, during the cruise of H. M. S. "Porcupine" in the summer of 1870, It is a small colony of irregular shape attached by a narrow base, to which sand, &c., is adhering (Pl. IV. fig. 6).

From the massive form of the specimen and the considerable thickness of the test there can be no doubt that it belongs to the genus *Polycyclus*, and it differs in many respects from the last described species and from all other known species of *Polycyclus*. It is closely allied in some respects to *Polycyclus lamarcki*, and I was at first inclined to regard it as being merely a variety of that species, but a detailed examination revealed so many points of difference that I believe it is best to describe it as a distinct though closely allied species.

The general colour is pale yellow or yellowish-grey. The ends of the Ascidiozooids next the common cloacal apertures are each marked by a short brownish-purple streak, which, as it is traced towards the branchial aperture, dies away in the middle line but is continued a little further anteriorly at the edges. The body of the Ascidiozooid is rather more opaque than the surrounding test, but of much the same yellowish colour. The base of the colony, where test only is present, is of a darker but more transparent grey with opaque white dots thickly scattered over it.

The systems are not very numerous, and are not nearly so closely placed as in the last species. They are always distinctly separated from one another (Pl. IV. fig. 6). The systems are all nearly circular in form, and contain about six to eight Ascidiozooids each. The part of the Ascidiozooid seen on the surface is of elongated ovate form, with the narrower end pointing towards the centre of the system. The largest ones measure about 2·5 mm. in length and 1·5 mm. in greatest breadth.

Under a low power of the microscope the small branchial aperture, surrounded by a rather large opaque white sphincter, can be seen. The endostyle and the peripharyngeal band are also visible, and there are two opaque white spots placed one in the middle of each side between the sphincter and the peripharyngeal band. The nerve ganglion is also visible, and in many of the Ascidiozooids the anterior part of the branchial sac can be made out, the outlines of some of the stigmata and the upper ends of the six internal longitudinal bars being seen. In one or two cases the tentacles are also distinguishable. In this species, as in *Botrylloides purpureum*, a much greater amount of the internal anatomy is visible from the surface than is usually the case. This is due mainly to the great transparency of the superficial layer of the test and the absence of pigment in the mantle.

The common cloacal apertures can be readily seen with the naked eye in most of the systems. They are nearly circular, and have projecting membranous margins. Under a slight magnification this margin is seen to be lobed, one lobe usually corresponding

to each Ascidiozooid in the system. The edges of the lobes are somewhat variegated, as they contain irregular patches of white and brown pigment.

In a section of the colony it is seen that the Ascidiozooids occupy merely a thin surface layer 1·5 mm. to 2 mm. in thickness, while all the rest of the colony is made up of the soft gelatinous grey test, like the part exposed at the base of the colony, but more transparent. The superficial layer of test all over the colony is modified into a thin transparent but firm membrane; when this is removed the underlying test is found to be very much softer. The vessels of the test in this species are decidedly narrow (see Pl. IV. fig. 8, *v.*), and sometimes very fine vessels may be traced for a long distance. The terminal knobs are large, and are always more or less globular in shape. Although the matrix is as a general rule homogeneous, still in some parts a delicate fibrillation can be made out. The stellate test cells are usually very distinct.

The mantle at first sight seems to have no musculature, but under a high magnification (300 diameters and upwards) very delicate fibres are found in some parts of it. These are decidedly finer than in most of the Botryllidæ, and very much finer than those in the mantle of *Polycyclus lamarcki*. The connectives between the branchial sac and the mantle are very thin, and are sometimes of considerable length.

The branchial sac is wider than usual (see Pl. IV. fig. 7), and the meshes are considerably larger than in any of the other Botryllidæ in the collection; they are wider than long, and have usually five or six stigmata each (Pl. IV. fig. 9). The usual arrangement is as follows, going along the side of the sac from the dorsal lamina to the endostyle:—first a dorsal series of eight stigmata, then the first or dorsal internal longitudinal bar, then a mesh containing five stigmata, then the second bar, then a mesh with six stigmata and the third or ventral bar, then finally a ventral row of nine stigmata bounded by the endostyle.[1] The transverse vessels in some cases vary a little in size, but there is no regular arrangement; they have slight horizontal membranes attached to their inner edges; they have usually a few delicate muscle fibres.

The endostyle is broad (Pl. IV. figs. 7, 10, *en.*). The dorsal lamina is very distinctly ciliated along its free margin. Its narrow anterior end has a curious undulating course (Pl. IV. fig. 10, *d.l.*). There is a certain amount of irregularity in regard to the eight smaller tentacles. They are always very short (Pl. IV. fig. 10), but in some cases they are reduced to mere stumps, and some of them may be absent altogether. The prebranchial zone is pear-shaped (Pl. IV. fig. 10, *z.*), and has the narrower end ventral as in *Polycyclus lamarcki*. Two rounded masses of yellowish-green pigment are found at the sides of the prebranchial zone, one immediately posterior to each median lateral tentacle (Pl. IV. fig. 10, *pig.*). These are the two opaque spots seen in the surface view of the colony (see above, p. 67). Similar cellular masses are found in the same position in *Pyrosoma*.

[1] This may be expressed shortly by the following formula :—D.L.—8 sg.—I.—5 sg.—II.—6 sg.—III.—9 sg.—En.

The dorsal tubercle is placed very close to the anterior end of the dorsal lamina (Pl. IV. fig. 10, *d.t.*), and there is no proper peritubercular area. In some cases there is a slight bulging posteriorly of the peripharyngeal band at one side of the dorsal lamina, thus producing a slight enlargement of the prebranchial zone (Pl. IV. fig. 10), but this can scarcely be regarded as a true peritubercular area. The opaque yellowish-brown mass formed by the nerve ganglion and neural gland is clearly visible through the dorsal lamina (Pl. IV. fig. 10, *n.g.*).

The alimentary canal is rather small (Pl. IV. fig. 7.). The œsophagus runs posteriorly with a slight ventral curve. The stomach is ovate in form and decidedly small. It is deeply channelled externally, and has a short recurved cæcum springing from the anterior edge of its intestinal end. The intestine, which is narrower than usual in the Botryllidæ, runs ventrally for a short distance (Pl. IV. fig. 7) and then turns anteriorly and dorsally, and after running parallel with the stomach but not touching it, reaches the œsophagus, and then turns anteriorly again to become the short rectum which ends in an anus surrounded by a prominent lobed margin. The cloacal region of the peribranchial cavity into which the anus opens communicates with the common cloacal aperture of the system by a long atrial siphon formed of a prolongation of the mantle and provided with circular muscle bands which may be regarded as a diffuse atrial sphincter (Pl. IV. fig. 7, *at.*). This atrial siphon is sausage-shaped (Pl. IV. fig. 11), and has not the bulbous form found in *Polycyclus lamarcki*. It is lined in its entire extent by an invagination of the test, which at the base of the siphon expands in the peribranchial cavity into a disk-like membrane with lobed or crenated edges (Pl. IV. fig. 11, *t.*)

No ova were found in this species. The reproductive organs are placed in the usual position (see Pl. IV. fig. 7), and consist only of rather small irregularly lobed spermatic vesicles. It is rather remarkable that while ova were present along with the testes in such a closely allied species as *Polycyclus lamarcki*, they should be absent in all the Ascidiozooids examined of the present species. Only a very few buds or young Ascidiozooids were discovered. These have masses of young ova placed laterally in the usual positions, and have no testes. Hence the probability is that this is a protogynous species like others of the Botryllidæ.

Family II. Distomidæ.

Colony rounded and massive, rarely incrusting, either sessile or supported upon a long or short peduncle.

Systems irregular, inconspicuous, or absent.

Ascidiozooids of moderate length and having the body divided into two regions, thorax and abdomen; they may be provided with long vascular ectodermal appendages.

Test gelatinous or cartilaginous, often thickened at the base to form a peduncle, which may be traversed by large canals containing the vascular appendages of the Ascidiozooids.

Branchial Sac well developed; usually no internal longitudinal bars present.

Dorsal Lamina in the form of languets, rarely a plain membrane.

Alimentary Canal placed at the posterior end of the branchial sac.

Reproductive Organs in the intestinal loop, or alongside it.

I use this family name in a somewhat different sense to that in which it has been employed by previous writers. Giard considered that the family Distomidæ contained three genera—*Distopa*, *Diazona*, and *Sigillina*. The last named form I regard as one of the Polyclinidæ, and *Diazona* seems to be a connecting link between *Chondrostachys* and *Clavelina*, and is therefore extremely difficult to place. Perhaps the best way might be to leave it, as Della Valle placed it in 1877, in a distinct family by itself. This reduces Giard's Distomidæ to the genus *Distoma*. To this Della Valle added *Distaplia* in 1881, and in von Drasche's classification (1883) we find the family Distomidæ consisting of these two genera with the addition of a subgenus of *Distoma*, viz., *Cystodytes*. In a distinct but adjacent family, the Chondrostachyidæ, he places Macdonald's *Chondrostachys* and his own *Oxycorynia*, both interesting forms. So far as I can make out from von Drasche's definitions and descriptions, he distinguishes the two families upon the rather slender ground that in the Chondrostachyidæ the colony is supported upon a peduncle traversed by canals, while in the Distomidæ this is not the case, but the Ascidiozooids are provided with vascular ectodermal appendages. Now in the Challenger collection there are a considerable number of forms which are allied to *Distoma* and *Distaplia* in certain characters but they have peduncles, in some cases long and in others short, and these peduncles are traversed by canals, which, however, contain vascular appendages prolonged downwards from the posterior ends of the Ascidiozooids. Hence it is perfectly obvious that these forms, to which I have given the generic title *Colella*, unite the characters of the Chondrostachyidæ and the Distomidæ, and consequently render it impossible any longer to separate the two families. I have retained the older name, derived from what has all along been considered as the central form of this group, viz., *Distoma*, but the family has now much wider limits than it has had hitherto, and embraces at least the genera—*Chondrostachys*, Macdonald, *Oxycorynia*, von Drasche, *Colella*, Herdman, *Distoma*, Gaertner, *Cystodytes*, von Drasche, *Distaplia*, Della Valle, and, probably, *Symplegma*, Herdman. Whether or not *Diazona*, Savigny, should be added must be left doubtful.

The general form of the colony throughout the family is very variable, but usually it is of large size. Sometimes it is an irregularly rounded mass (as in *Distoma crystallina*), occasionally it is a more or less incrusting layer (as in *Cystodytes draschii*); while very

frequently it is a stalked club-shaped mass, the upper swollen part of which may be short and globular (as in *Colella gaimardi*), or long and cylindrical (as in *Colella thomsoni*). In some cases systems with common cloacal openings are formed, while in others the Ascidiozooids are not arranged regularly, and each one has an atrial aperture communicating separately with the exterior. In the latter case the atrial aperture is six-lobed, in the former it has a large atrial languet. The branchial aperture is always six-lobed. The test varies greatly in its condition. It may be only moderately thick and remain soft and gelatinous, or it may become greatly thickened, forming a peduncle or a very massive colony, and it may be very dense and cartilaginous, or may even develop calcareous spicules (as in the genus *Cystodytes*).

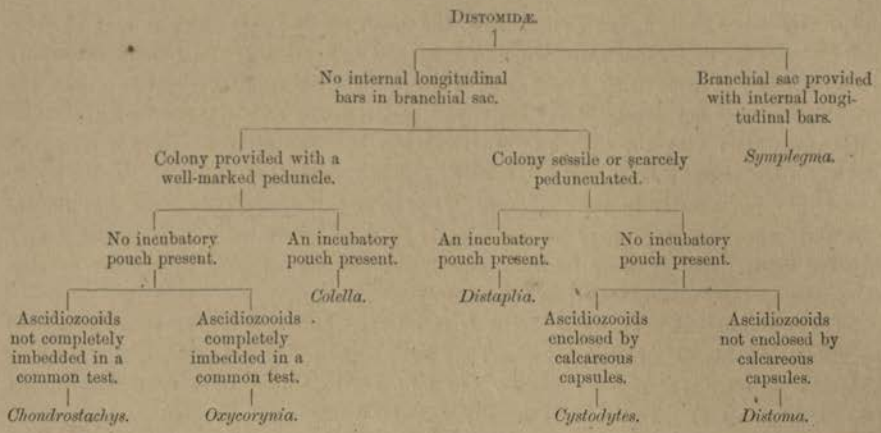
The Ascidiozooids are always of the *Distoma* type, and would have been considered by Milne-Edwards as "Didemniens." They have a thorax or branchial region, and an abdomen or intestinal region; usually the two are separated by a deep constriction (see Pl. XIV. fig. 5). There are generally vascular appendages or ectodermal processes, which, springing from the posterior ends of the Ascidiozooids, penetrate the test for considerable distances (Pl. V. fig. 13, and Pl. XIV. fig. 12, *v.ap.*), and may even branch to form networks like those met with in some Botryllidæ (see Pl. II. fig. 1, and Pl. XVIII. fig. 9).

The branchial sac varies greatly in size and number of stigmata. In *Distoma mucosa*, von Drasche, there are only three rows of stigmata, while in *Distoma adriaticum*, von Drasche, there may be as many as twenty-four. In some cases (*e.g.*, *Colella pedunculata*, Quoy and Gaimard) the stigmata may be very long and narrow, and more like those of some Simple Ascidians than of a Compound Ascidian. In *Symplegma* there are internal longitudinal bars, but in all other forms they are absent.

The alimentary canal also presents various conditions in the family. It may be short and thick, or it may form a long loop upon which the stomach is always a conspicuous organ. The wall of the stomach may be smooth or longitudinally folded or thickened irregularly.

There are usually a large number of spermatic vesicles, which all communicate by small ducts with a large vas deferens. The ova form a mass placed upon the intestinal loop and usually projecting beyond it. In some cases (*Distaplia* and *Colella*) the embryos undergo their development in a special prolongation of the peribranchial cavity, the incubatory pouch. The mature ova and the embryos are often of very great size (Pl. VII. figs. 7, 14, &c.). Gemmation takes place mainly, I believe, if not entirely, in connection with the vascular appendages. In some cases larval budding occurs.

The various genera in this family may be shortly distinguished by the following diagnostic characters :—



Of these seven genera, four are represented in the Challenger collections, viz., *Colella*, *Distaplia*, *Cystodytes*, and *Symplegma*.

Of the three remaining genera, *Chondrostachys* was described by Dr. J. Denis Macdonald in 1858 from a specimen found in Bass Strait, Australia; it has not, so far as I am aware, been rediscovered. It is a peculiarly interesting form, since it approaches *Diazona* and the Clavelinidæ in the partial independence of the Ascidiozooids. *Oxycorynia* was formed by Dr. R. von Drasche in 1882 for a species from the Caroline Islands. It is closely related to the new genus *Colella*. *Distoma*, finally, is the oldest and best known member of the family. It is distinguished superficially from the other genera by forming large massive generally sessile colonies.

Colella, n. gen.

Colony more or less club-shaped, and composed of a peduncle attached at the base and bearing on its summit a more or less ellipsoidal head.

Ascidiozooids imbedded in a common test, usually arranged in lines but not divided into systems. No common cloacal cavities visible. Body composed of thorax and abdomen and a long ectodermal process from the posterior end of the latter. Apertures six-lobed, not prominent.

Test gelatinous, penetrated by ectodermal prolongations from the Ascidiozooids.

Branchial Sac well developed; no internal longitudinal bars present.

Dorsal lamina composed of languets.

Alimentary Canal posterior to the branchial sac.

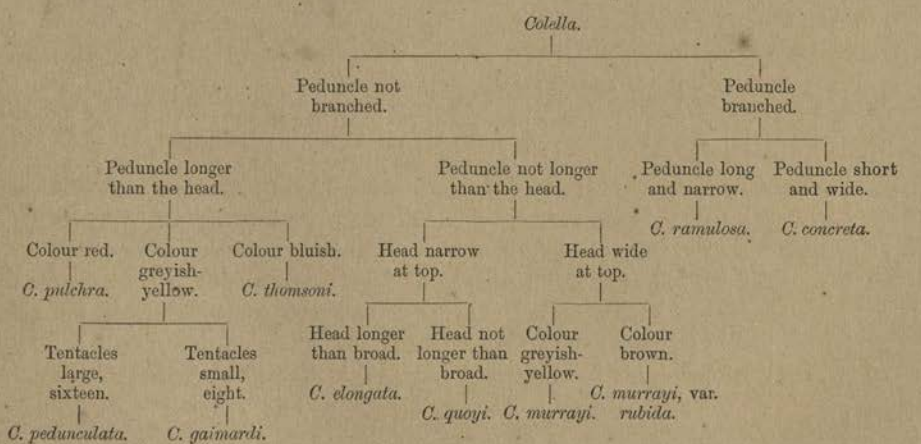
Reproductive organs placed on the left side of the intestinal loop. Testes grape-like in arrangement. Embryos develop in an incubatory pouch.

This genus is formed for a very striking and remarkable new species, *Colella thomsoni*, obtained near the Philippine Islands and some allied species from other parts of the world, but, as will be shown below, a species (*Colella pedunculata*) described fifty years ago by Quoy and Gaimard under the name of *Aplidium pedunculatum* also finds its place here. The two species, *Colella thomsoni* and *Colella pedunculata*, are very different in appearance, and at first sight seem to have nothing in common except that both are pedunculated Compound Ascidians. A careful examination, however, shows that they are really closely related.

The genus *Colella* is allied to *Oxycorynia*, von Drasche, and to *Distaplia*, Della Valle, and unites certain of their characters, the result being that it cannot be included in either of the older genera. Two courses are open, the first to unite the three groups under the generic title first published, *Distaplia*, 1881; the second to consider them as three distinct genera. I think there is sufficient difference between them to justify me in taking the latter course, but *Oxycorynia* and *Distaplia* can no longer be placed in distinct families as arranged by von Drasche, consequently I have, as is explained above, merged the Chondrostachyidæ in the older family, the Distomidæ.

Of the ten species of *Colella*, two (*Colella pedunculata* and *Colella thomsoni*) are described in detail. They are good species to take for this purpose, first on account of their central position amongst Compound Ascidians, and second on account of the fairly large size of the Ascidiozooids, especially in the case of *Colella thomsoni*.

The species of this genus may be distinguished by the following characters:—



Colella pedunculata (Quoy and Gaimard) (Pls. V.–IX.).

Aplidium pedunculatum, Quoy and Gaimard, Voyage de l'Astrolabe (Zoologie), t. iii. pt. 2, p. 626, pl. xcii. figs. 18, 19.

Aplidium pedunculatum, Cunningham, Voyage of the "Nassau," Trans. Linn. Soc. Lond., vol. xxvii. p. 490.

The Colony is club-shaped, and is attached by the base of a long peduncle, which increases in size as it is traced upwards to the ellipsoidal head in which the Ascidiozooids are placed. The surface is fairly smooth. The colour of the head is yellowish-grey; of the stalk yellow or brown.

Size—head, 1·5 to 3·8 cm. in length, 0·8 to 2·2 cm. in greatest breadth; stalk, 6·5 to 9·2 cm. in length.

The Ascidiozooids are imbedded in the common test, and are of fair size. The body of each is composed of thorax and abdomen with a long vascular appendage.

The Test is soft and gelatinous in the head, but hard and stiff in the peduncle.

The Mantle is rather thin, and the musculature is irregular.

The Branchial Sac is large, and has five rows of stigmata on each side. The transverse vessels are all of the same size. The stigmata are very long and narrow, and are regularly arranged.

The Dorsal Lamina is represented by a series of long triangular languets.

The Tentacles are sixteen in number and are all of the same size.

The Dorsal Tubercle has a simple circular aperture.

The Alimentary Canal is large, and extends for a considerable distance behind the branchial sac.

The Reproductive Organs are not of large size. They lie alongside the alimentary canal.

The Incubatory Pouch is very large, and may be coiled spirally.

Localities.—(*a*) Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

(*b*) Kerguelen Island, depth, 10 to 60 fathoms.

(*c*) Station 151, February 7, 1874; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ E.; depth, 75 fathoms; bottom, volcanic mud.

(*d*) Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 12 fathoms; bottom, sand and gravel.

(*e*) Station 314, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom, sand; bottom temperature, 46° F.

Fifty years ago Quoy and Gaimard[1] described a Compound Ascidian under the name of *Aplidium pedunculatum*. A short description and two coloured figures were given. The latter show a single specimen of the natural size (*loc. cit.*, fig. 18) and a magnified view of a small portion of the surface (*loc. cit.*, fig. 19). The colony exhibits a striking

[1] Voyage de l'Astrolabe (Zoologie), 1834, t. iii. pt. 2, p. 626, pl. xcii. figs. 18, 19.

resemblance in shape and general appearance to the Challenger specimens, but differs from them in several details. While comparing the two it will be convenient to regard the colony as composed of two parts: the "head" or the terminal enlarged part in which the Ascidiozooids are imbedded, and the "stalk" or elongated peduncle, which bears the head at its upper extremity. The lower end of the stalk is attached to some foreign body.

The general shape of the head and its size relatively to the stalk are the same in the figure and in the Challenger specimens, the only point in which they are not absolutely identical being that in the "Astrolabe" specimen the head evidently did not contract quite so much at its lower end as is the case in those from the Challenger; this, however, is unimportant, as in some specimens it is easy to distort the shape of the head by allowing it to lie in an abnormal position.

The colour of the head in the figure is bluish-grey, while that of the Challenger specimens is more of a yellowish-grey.

In the figure the Ascidiozooids are arranged in vertical lines which run distinctly in pairs; further, the Ascidiozooids in a pair of lines are placed alternately so that each has, as its neighbours above and below, Ascidiozooids belonging, not to its own vertical line, but to the adjacent one. The result of this arrangement is that besides vertical lines the Ascidiozooids form spirals more or less perfect, especially in the middle part of the head.

In the Challenger specimens this arrangement, though probably present, is not nearly so well marked (see Pl. V. figs. 1, 2, 3). The pairing off of the lines can be made out in some heads or in parts of them, but in many places is not at all distinct, and in all cases the Ascidiozooids seem to be closer together. Much the same may be said as to the alternate position of the Ascidiozooids in the lines; in some places it is evident (Pl. V. fig. 3), in others it is not very distinctly seen (Pl. V. fig. 2). Still the spiral lines are visible here and there. On the whole, the arrangement of the Ascidiozooids in the Challenger specimens seems to be more irregular than in the figure of the "Astrolabe" specimens, though following the same plan.

In shape the stalks are identical in both forms. In colour, however, they differ. In the figure the upper third is light indigo-blue, of a darker shade than the head, and the lower two-thirds are yellow. In the Challenger specimens the colour varies from pale yellow to light reddish-brown, but in none is any part blue; in some, however, at the point of junction with the head, there is a collar of a darker shade of yellow or brown.

In the other figure (*loc. cit.*, pl. xcii. fig. 19) three apertures are represented and seem to be intended for a branchial and two atrials. Both kinds are distinctly six-lobed. In the Challenger specimens it is exceedingly difficult to make out the condition of the apertures, on account of their contracted state; they are, however, six-lobed, but not nearly so distinctly so as in the figure. Turning now to the short description in the text, it is found to give less information than the figures did. Quoy and Gaimard's specific diagnosis is as follows:—"Aplidium, ovatum, griseo-violaceum, longe pediculatum;

osculis numerosissimis, luteis, lineatis." Then follows a short paragraph of remarks containing nothing of importance. The specimens were found at King George's Sound and Port Western in the south of Australia.

On the whole there can be little doubt that this is our species. The differences in shape and arrangement of the Ascidiozooids are slight, and it has been seen that there is a certain amount of variation in these particulars among the Challenger specimens themselves. The appearance of blue in the "Astrolabe" specimen is more puzzling, but is not, I think, sufficient to separate the two forms. In ours the shades of grey, yellow, and brown vary considerably, and the "Astrolabe" one may have been abnormally coloured. It must also be remembered that the Challenger specimens have been in spirit for some years. The figure showing the lobed apertures with such wonderful distinctness and regularity may perhaps have been taken from the living animal, certainly nothing so perfectly regular is visible in the apertures of the Challenger specimens.

The only other reference to this species I can find is in the report on the animals obtained during the cruise of the "Nassau."[1] Professor R. O. Cunningham there reports from the Strait of Magellan, "*Aplidium pedunculatum*, Quoy and Gaimard, attached to *Macrocystis*."

During the Challenger Expedition this species was taken at six localities, viz., (1) at Station 313, at the eastern end of the Strait of Magellan, from a depth of 55 fathoms (five specimens); (2) at Kerguelen Island, 20 to 60 fathoms (one specimen); (3) at Kerguelen Island, 10 to 60 fathoms (three specimens); (4) at Station 151, south-west of Heard Island, 75 fathoms (1 specimen); (5) at Station 315, on the east coast of the Falkland Islands, 12 fathoms (1 specimen); and (6) at Station 314, between the Strait of Magellan and the Falkland Islands (2 specimens).

An examination of the external features alone of this form suffices to show that it does not belong to the genus *Aplidium*, as stated by Quoy and Gaimard and later by Cunningham, or even to the family Polyclinidæ; while the dissecting out of one of the Ascidiozooids from the common test shows that it is a member of the Distomidæ, but differs somewhat from the recognised genera. It is found, however, to agree in all essential particulars with the new and remarkable species *Colella thomsoni* and the other members of the same genus, to be described further on, and consequently the present species must be placed in the new genus *Colella*. Quoy and Gaimard's specific name *pedunculatum* is retained. It must be remembered, however, that the name was given when the species was supposed to be an *Aplidium*, and that the possession of a peduncle is a character common to all the species of *Colella*. As the animal had never been properly examined, I have submitted it to a detailed investigation, and, as it has some interesting peculiarities, an account is inserted here of the anatomy and histology for comparison with the detailed description of *Colella thomsoni* which will follow (p. 94).

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 490.

Anatomy.

The colony is somewhat club-shaped (Pl. V. fig. 1), and may, for convenience of description, be divided into the stalk and the head. The stalk is attached by its lower extremity to some foreign body, and bears the head on its upper end. It is long and rather slender. It tapers downwards from the point of junction with the head to within a short distance of the lower end, where it spreads out to form a base of attachment (Pl. V. figs. 4, 5). It is generally undulating in its course, sometimes twisted spirally, marked with faint longitudinal striæ, and often wrinkled transversely (Pl. V. fig. 1); in one or two specimens it is slightly constricted just below the head, thus forming a sort of neck. In colour it varies from light yellow (straw colour) to light reddish-brown. In a few specimens there is a collar or darker band of brown just below the head. Opaque yellow dots of varying sizes up to 0·5 mm. may be seen, especially if the stalk be held up to the light, in the interior. They are largest and most numerous at the upper end (see Pl. V. fig. 10).

The head is roughly ellipsoidal in form; sometimes it is more of an oval, the pointed end being downwards. The investing mass between the Ascidiozooids is of a dull grey colour. There is always a patch of this to be seen, free from Ascidiozooids, at the summit of the colony. The Ascidiozooids appear externally as pale yellow blotches arranged in vertical lines. They are largest at the summit of the colony round the terminal bare patch, and gradually decrease in size as they are traced downwards to near the lower end. Here they rapidly get smaller, closer together, and less distinct till finally they are lost to sight at the top of the stalk. In some Ascidiozooids nothing more than the outline is visible, but in many a minute bright yellow opaque-looking dot is seen near the centre of the anterior extremity (Pl. V. fig. 2).

The head is essentially a mass of grey test, in the outer layer of which the Ascidiozooids are imbedded. Its inner part is traversed by the vascular appendages, which run inwards and downwards from the posterior or inner extremities of the Ascidiozooids. At the summit of the colony there are, as mentioned above, no Ascidiozooids, and of course no appendages, therefore in a transverse section of this region nothing but the grey test is seen. Here, however, it has generally a somewhat spongy, and, on the surface, ragged appearance (Pl. V. fig. 2).

In a section through the colony about the level of the top row of Ascidiozooids (Pl. V. fig. 7) an irregular disk of grey test is seen, having a few Ascidiozooids and masses of embryos lying in its periphery, and extending in nearly to the centre.

A transverse section about the middle of the colony (Pl. V. fig. 8) shows the same disposition of Ascidiozooids and of embryos in various stages of development, but here they only occupy the outer half of the disk, leaving in the centre a circular piece of grey substance which is more or less spongy as it is traversed by canals containing the

appendages of the Ascidiozooids above. These are at first few in number, and are chiefly in the central part, but as they descend through the colony their number increases till at the base of the head they are found throughout the whole extent of the central mass of test (Pl. V. fig. 9 and Pl. VIII. fig. 11).

The canals containing the vascular appendages are continued down into the stalk. At the upper end they are very numerous (Pl. VIII. fig. 10), but as they descend they gradually decrease in number, till at the base of attachment a section shows nothing but the test substance.

The masses of embryos referred to as seen in sections of the head appear in the form of spirally coiled sacs lying one alongside each Ascidiozooid, and attached to it by a narrow pedicle (Pl. V. fig. 13).

In sections of the stalk the yellow bodies mentioned above as being visible externally are seen imbedded in the ground tissue (Pl. VIII. figs. 1–9). They are largest and most numerous near the upper end of the stalk. They will be minutely described further on (page 90).

The outer layer of the stalk is seen in sections to form a kind of cuticle, to the surface of which sand, &c., is sometimes attached, and which is of a firmer nature than the spongy central part. To this cuticle is due the yellow or brown colour of the stem, the inner part being of a grey colour.

Histology.

Investing Mass or Test.—This is the grey substance or ground mass out of which the greater part of the colony is formed, and it is homologous with the "test" of the Simple Ascidian. Its structure is well seen in a section of the bare patch at the top of the colony (Pl. V. figs. 14, 15). It consists of a hyaline homogeneous matrix in which cells are imbedded. These are of two kinds, of which one is very remarkable. They are very large (0·04 to 0·08 mm.); oval, spherical, ellipsoidal, or polygonal in shape; hollow inside, and suggest at once the name "bladder cells," having in fact only a thin layer of protoplasm lining the inner wall, against which the nucleus lies. The nuclei are very distinct (the largest being about 0·008 mm. in length), they are round, oval, or fusiform in shape, stain readily with carmine, and are always situated close to the inner wall of the cell. There is often a little mass of protoplasm at the point where the nucleus lies. The outlines of these cells are very delicate, but distinct and beautifully regular (Pl. V. fig. 15). They are very numerous, forming by far the greater part of the tissue. Even in the places where they are least numerous they encroach so much on the matrix as to reduce it to a strongish network between the bladder cells. In other parts the matrix exists only in the form of delicate threads and membranes surrounding the large vesicles, while in some places the latter have increased to such an extent that no matrix

is visible, and the bladder cells have become polygonal by mutual pressure (Pl. V. fig. 17). The second form of cell is found wherever a small patch of matrix can be seen. They are the test cells, and are small (0·008 to 0·01 mm.), ellipsoidal, fusiform, or stellate in shape, and consist of a large nucleus surrounded by a little protoplasm which sometimes stretches out to form long delicate processes. These cells stain deeply with carmine.

Under a low power (50 diameters) this test tissue looks like a fine network minutely dotted over (Pl. V. fig. 14). The meshes are formed by the bladder cells, of which several layers may be in focus at once, and the dots represent the nuclei of both kinds of cells. When magnified 200 diameters the structure is apparent (Pl. V. fig. 15). The outlines of the large bladder cells seem to cut each other constantly; this is due to the fact that more than one layer is visible. If care be taken to focus three or four cells lying in the same plane, it will be seen that they never intersect or open into one another, and that except when they are very crowded a thin layer of matrix lies between them. In some places under this power the tissue looks as if composed of large protoplasts (the patches of hyaline matrix, containing the small fusiform cells with large nuclei) united to one another by radiating processes and leaving large lacunæ between (the bladder cells). This appearance is very striking in some preparations stained with picrocarmine (Pl. V. fig. 17).

A higher power (350 diameters) shows better the nuclei of the bladder cells and their parietal position. Coarse granules are generally visible in these nuclei. Throughout the rest of the head the investing mass has essentially the above described structure; the bladder cells, however, are generally not quite so large, and are much more crowded, being polygonal in shape; sometimes they form regular hexagons, showing no matrix except here and there at the angles. The central part of the head, as mentioned above, is quite spongy in appearance, being channelled out by the vascular appendages. Under a low power (50 diameters) a section of this region presents a curious appearance (Pl. V. fig. 16). The large spaces (about 0·2 mm. across) reduce the tissue to an irregular reticulum, the thick bars of which have the ordinary structure of bladder cells, &c., while here and there are seen threads too narrow to contain a bladder cell; these are formed of the matrix, with its small spindle-shaped test cells.

Towards the base of the colony, on account of the greater number of vascular appendages which have to be accommodated, the spongy area is greater in extent and the amount of tissue in the spongy part is less, being reduced to bars of nearly uniform thickness which enclose spaces of hexagonal form, thus making a regular network (Pl. VIII. fig. 11).

Over the whole head the surface layer of the test tissue differs slightly in structure from the central part (Pl. V. fig. 17). It contains no bladder cells, but is formed merely of the homogeneous matrix and the small fusiform or stellate test cells. This layer can be stripped off as a delicate membrane from the surface of the tissue beneath. The

layer of test which immediately surrounds each Ascidiozooid is also of the same nature, being destitute of bladder cells.

The peduncle is composed chiefly of the same tissue which forms the test or investing mass in the head. The external layer, however, is somewhat modified (Pl. VIII. figs. 6–8); it is very compact, contains no bladder cells, shows an indication of fibrillation, and is of a yellow or yellowish-brown tint. To its external surface grains of sand are sometimes found adhering. This external cuticle passes gradually into the normal tissue of the stalk (Pl. VIII. fig. 8), which shows a homogeneous matrix containing bladder cells, generally isolated, and never so numerous as is the rule in the head, and many of the ordinary small fusiform and stellate cells; these are arranged in the outer part so as to form rows more or less parallel to the outer edge of the section.

At the very base of the colony the tissue is compact, but a short distance up (Pl. VIII. figs. 2, 6) a few tubes channelled through it and placed at first in the centre of the section are met with. Further up these increase in number and encroach more on the peripheral layers, till, near the top of the stalk, they are found scattered over the whole section except in a narrow zone just under the cuticle. These canals contain the downward prolongations of the vascular appendages already mentioned as being continued through the test from the posterior extremities of the Ascidiozooids. The vascular appendage occupying a canal appears as a thin-walled tube of varying width, divided longitudinally into two cavities by a delicate septum, so that in reality the vascular appendage is formed of two vessels running side by side (see Pl. VIII. figs. 10, 11, 12, *v. ap.*).

In sections of the stalk the small yellow dots which were visible externally are frequently met with. These are now seen to be gemmæ or buds in various stages of development (Pl. VIII. figs. 6, 7, 8, 9, *emb.*). They begin to appear a short distance above the base of the stalk, increase in number (for a certain time), and advance in development as they are traced upwards.

Mantle or Muscular Coat.—This layer forms the true body-wall of the Ascidiozooid. It covers all the other organs of the body, and lies directly under the investing test, with which, however, it is throughout the greater part of its extent not closely connected. A cavity, in spirit specimens at least, in which the Ascidiozooid lies is distinctly visible. The mantle is united to the test at the apertures, and is in close contact with it on the vascular appendage and the incubatory pouch. In the living animal, however, when the muscles were relaxed and the peribranchial space filled with water, the mantle was doubtless in contact with the test throughout, and there was therefore no cavity around the Ascidiozooid.

The mantle is a delicate sac with two openings, and having rather an elaborate shape, covering as it does all the organs and appendages of the body. Its form therefore is the same as that of an Ascidiozooid dissected out from the test, which will now be described.

The Ascidiozooid (Pl. V. fig. 13) may be divided into the body, the vascular appendage (*v. ap*), and the incubatory pouch (*n. p.*). The body, like that of all the Distomidæ, consists of two regions, the thorax and the abdomen. Of these the thorax is rather the larger, and is the more anterior or superficial of the two. It is flattened laterally and is rudely quadrangular in shape, the ends being anterior and posterior, the margins dorsal and ventral, and the sides right and left. It has the branchial and atrial apertures at its anterior extremity, is united to the abdomen posteriorly by a narrow neck, and has the incubatory pouch as a large diverticulum on its dorsal edge. The thorax consists of the branchial and atrial siphons, the branchial sac with all its contained organs, the tentacles, the nerve-ganglion and the neural gland, the upper part of the œsophagus, the terminal parts of the rectum and genital duct, and the atrium or peribranchial space—the whole being surrounded by the mantle.

The abdomen lies posterior to or deeper than the thorax, to which it is united by a narrow neck formed of the œsophagus, the rectum, the genital duct, and a covering of mantle. The abdomen is smaller than the thorax, is of an oval or ellipsoidal shape, and has the long vascular appendage attached to its posterior extremity. It contains the remaining organs of the body, namely, the stomach and intestine, the genital glands, and the heart.

The vascular appendage starts from the posterior end of the abdomen on the right side, and runs, as will be more minutely described hereafter, inwards and then downwards through the colony.

The incubatory pouch is a large spirally coiled diverticulum from the peribranchial space, with the dorsal part of which it communicates by a narrow duct.

The mantle forms the outer wall of this irregularly shaped body, the parts of which have just been enumerated. It does not vary much in thickness; the part covering the abdomen, however, is thinner than that on the thorax, which, excluding the siphons, is nearly equally strong all over; the neck of the incubatory pouch is thicker than the rest of that sac, the farther end being rather weak. The parts forming the two siphons are the strongest of all (Pl. VI. fig. 2), and the marginal lobes of the branchial aperture especially predominate (Pl. VI. fig. 4, *br.*).

Histologically the mantle is composed mainly of three elements—the connective tissue, the muscles, and the epithelium. The connective tissue is the ground-work, and is present in the form of a thin hyaline homogeneous membrane, containing many scattered cells; it encloses and joins the bundles of muscle fibres, and is clothed on its inner surface by a layer of tessellated epithelium. The connective tissue cells are round, fusiform, and stellate in form, have granular protoplasm, and generally distinct nuclei which stain readily with carmine. In some parts of the mantle, as, for example, on the thin part of the incubatory pouch, many stellate cells are present, and the long processes of adjacent cells unite, forming an intricate network. On the narrow neck of the incu-

batory pouch the cells are fusiform, and are arranged with their long axes placed along the length of the neck. They are very close together, and form a nearly compact tissue of longitudinally placed rows of cells. These fusiform cells have their ends in many cases greatly drawn out so as to resemble fibres. Cells of the normal spindle-shape without the terminal fibres occur also on the lobes at the margins of the apertures. Here also, as on the neck of the pouch, they form a rather compact layer.

The muscle fibres are non-striped, very long, almost colourless, stain yellow with picrocarmine, and exhibit no traces of a nuclei. The different parts of the mantle vary greatly in the amount and disposition of the musculature. In the thin part covering the abdomen, and adhering closely to the subjacent organs, muscular fibres are usually not visible at all, though occasionally in the upper part, next the thorax, a few delicate stragglers may be seen. The thorax, on the other hand, has fibres running in almost every direction. They are arranged in bands, generally two or three fibres thick, which branch and unite again (Pl. VI. fig. 5); single fibres being alone for short distances only, as when they stretch from one band to an adjacent one. A number of bands are more or less transversely placed, encircling the middle and lower part of the thorax as a series of equidistant parallels (Pl. VI. fig. 4); often, however, they are more irregular. This is the rule on the anterior part of the thorax where the bundles cross at all angles and seem at first to have no definite arrangement. On account of the anterior curvature the circular bands, as they pass over the dorsal and ventral margins, are directed posteriorly, this gives them an oblique course and causes a decussation of those from the two margins (Pl. VI. fig. 4). A few longitudinal fibres are also present running down the sides of the thorax from the sphincter muscles of the apertures. These cross the densest part of the decussation of the circular fibres, which is in the middle of each side just posterior to the branchial aperture, and thus form a patch from which fibres seem to radiate in all directions. On each side, near the ventral margin, a long and rather close bundle of fibres may be seen running in a curved direction from the branchial siphon to the posterior end of the sac where the fibres diverge, many of them sweeping round to the dorsal edge.

The ventral margin over the endostyle (Pl. VI. fig. 4) seems to be more muscular than the corresponding region of the dorsal edge, the bands also cross, branch, and anastomose more frequently; possibly this may be accounted for by the more anterior position of the ventral margin, the atrial aperture being slightly posterior to the branchial. Circular muscle bands act as sphincters at the two apertures (Pl. VI. figs. 2, 3, 4). They are placed around each siphon and the fibres are much coarser and closer than on any other part of the thorax. The branchial sphincter is stronger than the atrial.

Over the incubatory pouch the musculature, though stronger than over the abdomen, is feebly developed. In the young pouch not a fibre is visible, but in those which

are fully developed delicate and rather distantly placed bands, occasionally forking, are to be seen. Near the neck in some pouches the bands become stronger and more numerous.

The epithelial elements of the mantle are represented by, (1) the ectoderm externally separating the test from the mantle and covering the latter in its entire extent. Over the incubatory pouch and in some other parts the ectoderm cells are provided with long, pointed, hook-like processes which extend outwards into the test, bolting the two tissues together (Pl. VI. figs. 7, 8); and (2) a single layer of tessellated epithelium is placed on the inner aspect and clothes the surface of the connective tissue. It is of extreme tenuity and delicacy, being only visible under the most favourable circumstances. Here and there, when looked for carefully, the outlines of small groups of cells may be distinguished in the unstained tissue; usually, however, nothing is to be seen. By using nitrate of silver or osmic acid the outlines are rendered much more distinct, and, in most cases, the nuclei are also displayed (Pl. VI. fig. 9). The cells are polygonal (four-, five-, and six-angled), form a continuous layer, and seem perfectly transparent. The nuclei are of moderate size, circular in outline, placed near the centre of the cell, and seem finely granular in texture. This layer of epithelium is the "parietal layer of the atrial membrane" of Huxley, the "lining membrane" of Hancock, or the "third tunic" of Milne-Edwards. It forms the bounding wall of the peribranchial cavity or atrium, and is directly continuous with the outer of the two membranes which enter into the formation of the wall of the branchial sac.

Branchial Sac.—This organ occupies the greater part of the thorax, almost entirely filling the peribranchial cavity. It is composed fundamentally of two delicate membranes, the outer being the visceral layer of Huxley's atrial membrane, and the inner the endoderm of the anterior portion of the alimentary canal. These during the course of development are approximated, through the enlargement of the pharynx, come into close contact at different points, and fuse together. These places gradually grow thinner, and finally become perforated, thus forming stigmata, while the tracts over which the membranes do not unite remain as hollow canals, the blood-vessels of the branchial sac.

The organ in this species is a flat sac shaped somewhat like the letter B (Pl. V. fig. 13), having an indentation near the middle of its ventral edge. Besides the stigmata, which communicate with the peribranchial space, it has two orifices, one at the anterior end, the branchial aperture or mouth, by which water and food enter the organism, and the other near the posterior end, the œsophageal aperture, by which food enters the alimentary canal.

The endostyle (Pl. V. fig. 13, *en.*) runs along the ventral, and the dorsal lamina along the dorsal edge of the branchial sac, while the circlet of tentacles, the dorsal tubercle, and the peripharyngeal band are situated at its anterior extremity. All these organs will be described further on.

The stigmata occur over the whole interior of the sac, from the peripharyngeal band

anteriorly to the base where the œsophagus opens posteriorly, with the exception of a narrow band along the dorsal and ventral edges, where the dorsal lamina and endostyle are placed. They are arranged in horizontal (transverse to the antero-posterior axis) rows, and are separated by transverse and longitudinal vessels (Pl. VI. fig. 10, *tr.* and *l.v.*). There are about five such rows and about twenty stigmata in each row in the adult animal. In shape they are elongated slits with parallel sides and rounded ends (Pl. VI. figs. 10, 11, 17).

The vessels or blood channels of the branchial sac are divided according to their direction into two groups, the transverse and the longitudinal. The transverse vessels are the largest. They run round the sac horizontally, forming arcs of circles springing at the two ends from the great dorsal and ventral thoracic trunks, which communicate more or less directly with the heart, and giving off anteriorly and posteriorly the slender longitudinal vessels which separate the stigmata. These longitudinal vessels forming the second group, besides being smaller in calibre, are much shorter than the transverse, and merely form short connecting ducts between these latter.

The walls of the longitudinal vessels show externally a single layer of flat cells like those on the inner surface of the mantle, but more easily made out (Pl. VI. figs. 12, 13). The cells are often rhomboidal or pentagonal in shape, and have large nuclei which are distinctly seen after staining with nitrate of silver. The walls of the larger transverse vessels show the same structure with the addition of a few muscle fibres running along their length. What seems from the interior or exterior of the sac a single row of ciliated epithelial cells surrounds each of the stigmata (Pl. VI. figs. 11, 12, 13), that is, rests on the outer wall of the longitudinal vessels, along the sides of the stigma, and for a very short distance on the transverse vessels at the two ends. When, however, a transverse section of one of the small longitudinal vessels (Pl. VI. fig. 15), or a view of the vessel from the stigma (Pl. VI. fig. 14) is obtained, it is seen that each apparent cell is in reality three or four narrow cells placed side by side so as to form a longitudinal band of ciliated epithelium extending down the side of the vessel. These ciliated cells vary somewhat in shape, being found in all intermediate degrees between barrel-shaped and mitriform or shortly conical (Pl. VI. figs. 12, 13); the free ciliated edge is always the more convex one. The most common form is nearly semicircular (Pl. VI. fig. 11), the flat face being next the vessel and the curved one next the stigma. These cells have strongly marked outlines, granular contents, and distinct nuclei placed rather below the middle (the non-ciliated side being the base). The nuclei vary in shape according to that of the cell. When the latter is barrel-shaped they are elongated (Pl. VI. fig. 12), while in the semicircular and conical forms they are circular in outline (Pl. VI. fig. 13). The cilia are long and delicate. There are from five to ten on each cell, attached to the more or less convex outer edge, and when fully extended they are about twice the height of the cells (Pl. VI. figs. 11, 12, 13).

The branchial sac is shown by its relations and development to be a pharynx greatly enlarged and modified to serve as a respiratory organ. The water, when the muscular mantle is relaxed, enters the sac by the branchial siphon and streams through the stigmata into the peribranchial space, bathing in its passage all the thin-walled vessels and aerating their contained blood. The current of water is directed by the lashing of the cilia bounding the stigmata. In nearly every specimen examined one or two small Copepod Crustaceans were found living in the branchial cavity as commensals.

Endostyle.—The endostyle runs along the ventral edge of the branchial sac (Pl. V. fig. 13 *en.*). It begins anteriorly at the base of the branchial siphon immediately behind the peripharyngeal band and runs backwards to the base of the sac, ending at the ventral edge of the œsophageal aperture. The ends are bluntly conical (Pl. VI. fig. 4), otherwise it is of the same breadth throughout. Its course is far from being a straight one. In its longitudinal and lateral plane (from side to side) it forms a series of minute undulations, which are sometimes especially marked in its anterior part (Pl. VI. fig. 3, *en.*), while in its longitudinal dorso-ventral plane (Pl. V. fig. 13) it describes two large curves of nearly equal size with the convexity outwards (ventrally) and separated by a deep depression; these form the B-shaped ventral edge of the branchial sac.

The endostyle is a groove with greatly thickened sides formed of columnar epithelium, while the base is covered with squamous epithelium. The summits of the edges are continued up as lip-like folds, which sometimes arch over so as to form what seems to be a canal. A tract along each side and the base are richly ciliated. Seen from the dorsal or ventral aspects, the endostyle shows a pair of thick brown semi-opaque bands separated by a more translucent area (Pl. VII. fig. 2). The opaque bands are caused by the thickened sides, separated by the less massive floor of the groove.

Dorsal Lamina.—This is probably the best designation for the very variously named organ which runs along the dorsal edge of the branchial sac opposite to the endostyle. It varies greatly in the details of its structure in different Ascidians, but two chief modifications are generally recognised—(1) where it occurs as a lamina or membrane, and (2) as a series of tongue-like processes or languets. These two conditions of the organ look very different, but are really merely the extreme modifications of intermediate stages which are also found. Beginning with the lamina or simple broad membrane, we find that this may be traversed by horizontal equidistant ribs or thickenings more or less strongly marked. The next stage is when these ribs, extending to the free edge of the membrane, form thereon, when seen in profile, a series of slight tubercles. These marginal tubercles are found in every degree of development, from the merest points up to large teeth and finally long conical languets. As a rule the breadth of the membrane seems to be in inverse ratio to the development of the marginal tubercles. In working through a series of dorsal laminæ, as the tubercles increase in size the membrane

between them becomes more and more crenated till finally a point is reached where the dorsal lamina exists no longer as a membrane but is replaced by a series of triangular or conical processes.

In the species under consideration the dorsal lamina is in an intermediate condition. A membranous band extends along the dorsal edge of the sac, from the peripharyngeal band to the œsophageal aperture, and from this a series of long thin pointed processes spring at nearly equal distances. Each process or languet is placed at the intersection with a transverse vessel, is about 0·1 mm. in length, is roughly triangular in outline (Pl. VII. fig. 3), and has somewhat undulating edges. A delicate membrane extends between the languets in a series of festoons, but does not reach quite to their points.

Tentacles.—The tentacles are placed in a circle round the base of the branchial siphon just at the entrance of the branchial sac. The branchial siphon is a short funnel formed by the mantle and having the thickened six-lobed margin already described. Its inner surface is lined by an invagination of the outer test, which is of extreme delicacy and transparency, and extends as far down as the tentacular circlet. This point therefore may really be considered as the mouth of the animal, the siphon being merely a depressed portion of the surface leading to the true oral aperture.

The tentacles (Pl. VII. figs. 2, 6) are simple, long, and rather stout, being large in proportion to the size of the animal. When directed upwards they project beyond the external opening of the branchial siphon. They are about sixteen in number, and are all nearly of the same length. They are attached by their bases to a strong muscular band which encircles the base of the branchial siphon, it has the lower end of the invaginated test attached to its upper edge, and is in relation with the prebranchial zone by its lower edge.

Each tentacle is attached separately and has a swollen base, a round tapering and generally curved stem, and a rather blunt apex. Along one side a strong band of cubical ciliated epithelium is placed (Pl. VII. fig. 4). The rest of the wall of the tentacle is formed externally of squamous epithelium (Pl. VII. fig. 4). In the interior, near the concave side, a dark line is seen running from the base nearly to the extremity. This is a septum formed of connective tissue and dividing the interior into two cavities just as in the tentacles of Simple Ascidians.

The Peripharyngeal Band is composed of a row of ciliated cells and encircles the top of the branchial sac (Pl. VI. fig. 3, *p.p.*). It is connected at its ventral and dorsal ends with the anterior extremities of the endostyle and dorsal lamina. In the bay formed where it curves posteriorly to meet the latter, the dorsal tubercle is placed (Pl. VII. fig. 6).

Anterior to the peripharyngeal band is a clear space extending nearly to the base of the tentacular circlet. This is the zona prebranchialis (Pl. VII. fig. 2). Its upper boundary is formed by a ciliated circle like the peripharyngeal band, and placed just

behind the tentacles. It has a remarkably undulating course (see Pl. VII. fig. 2), and is rather broader than the peripharyngeal band.

Dorsal Tubercle.—This organ (Pl. VII. fig. 6) is placed at the anterior end of the dorsal edge of the branchial sac, just in front of the end of the dorsal lamina, and in the bay formed by the bending posteriorly of the peripharyngeal band. It lies in the prebranchial zone, and is therefore anterior to the peripharyngeal band. On account of the blood sinus immediately superficial to it, which contains in this species a mass of very opaque white corpuscles (Pl. VI. fig. 3, *n.g.*), it is only in a few cases, and with great difficulty, that the dorsal tubercle can be made out at all. Its outline is oval or nearly round, and the aperture is simple (Pl. VII. fig. 6).

Nerve Ganglion.—The nerve ganglion (Pl. VII. fig. 5) is in its usual position on the dorsal side of the branchial aperture, nearer the branchial than the atrial aperture. It lies in the inner part of the mantle, and is covered by a large blood sinus (Pl. VI. fig. 3, *n.g.*), on account of which it is only visible from the inner aspect. It is elliptical or nearly circular in outline, the ends being a little pulled out where the nerve fibres run outwards towards the two apertures (Pl. VII. fig. 5).

The Alimentary Canal is contained partly in the thorax and partly in the abdomen. Excluding the branchial sac, it may be divided into three parts, the œsophagus, the stomach, and the intestine (Pl. V. fig. 13).

The œsophageal opening is placed at the posterior end of the branchial sac, nearer the dorsal than the ventral edge, but pointing towards the endostyle, from which it is separated by a slight elevation. A short wide œsophagus (Pl. VII. fig. 7) leads backwards and dorsally to the cardiac end of the large stomach. The wall of the œsophagus is lined by columnar epithelium, and is rather thin. Seen on the inner surface, the cells form an irregular minute mosaic; their nuclei are generally not visible.

The stomach (Pl. VII. fig. 7; and Pl. V. fig. 13, *st.*) is a large cavity of somewhat oval form, the anterior or cardiac end being the largest. Its outer (dorsal) edge is sometimes flattened or even depressed in the centre, but is usually gently convex. The internal (ventral) edge is always convex, and is shorter than the outer edge. The internal surface of the stomach is not raised into any folds or rugæ, such as are found in some other Compound Ascidians. The wall is thicker than that of the œsophagus, and is lined by columnar cells with shorter columnar, fusiform, or irregularly shaped smaller cells between and below them. As in the wall of the œsophagus, the inner ends of the cells present a mosaic-like appearance.

The intestine (Pl. VII. fig. 7) begins at the pyloric end of the stomach, runs downwards and inwards for a short distance, then turns upwards and runs nearly parallel with the œsophagus till it reaches the level of about the middle of the stomach, then it curves round to the dorsal side, crossing the upper end of the œsophagus; and finally, turning anteriorly, becomes the rectum, which courses along the dorsal edge of the left

side of the branchial sac in its lower half, and terminates by opening into the atrial cavity. The anus is inconspicuous, being furnished in the adult Ascidiozooid with no lips, lobes, or raised margins, such as are seen in many Compound Ascidians. In a young specimen observed, however, the rectum was provided at its termination with a thickened border. It is just possible that this difference may be due to the fact that in the latter case the rectum was empty, while in the adult Ascidiozooids it was always found distended with fæcal matter.

From the above course it follows that the alimentary canal first runs dorsally, then ventrally, then ventrally again, and finally dorsally, and therefore describes a curve of which the first half has the convexity dorsal, and the second half has the convexity ventral.

The wall of the intestine has much the same structure as that of the stomach. On its inner surface, however, an arrangement of large clear cells may be seen, placed generally in a single row, and forming a wide-meshed network. No distinct nuclei are visible, but in some granules are present. As no concretions are ever found in them they cannot represent the renal vesicles seen on the intestine of some Simple Ascidians. Probably they secrete a digestive fluid and correspond to the gland which has been described as occupying a similar position in many other Compound Ascidians (see p. 22).

Blood-Vascular System.—The heart lies on the right side of the abdomen, close to the inner (ventral) edge of the stomach. It is a delicate fusiform tube with undulating walls, and is enclosed in an outer also very delicate membrane, the pericardium, which can only be made out with difficulty. At its anterior end the heart gives off two large vessels which run upwards to the thorax alongside the intestine, and are soon lost to view. At the posterior end three vessels are given off from the heart. One runs upwards along the stomach, another along the intestine, and the third is continued backwards into the vascular appendage, which traverses the peduncle and plays an important part in the process of gemmation.

Reproductive Organs.—The ovary is placed on the left side of the abdomen (Pl. VII. fig. 7), and, in the young condition, is confined to the intestinal loop. When it has attained its adult size, however, it spreads far beyond, covering the intestine in its lower part and extending beyond it on the ventral side enclosed in a sac-like diverticulum of the mantle (Pl. VII. fig. 8). The ova are distinctly visible, and vary in size from about 0·02 mm. to 0·15 mm. in diameter; the larger ones exhibit the germinal vesicle and germinal spot. The smallest ova observed are collected together to form a mass which lies generally at the base of the ovary (Pl. VII. figs. 9, 10). These young ova are irregular in shape, and are often triangular from mutual pressure. They have distinct strongly refracting nuclei resembling the germinal spots of larger ova, and the surrounding protoplasm stains very deeply with carmine. The mature ovum (Pl. VII. fig. 11) is spherical and of a yellowish-brown colour. It has a large germinal vesicle and a

strongly refracting germinal spot, both circular in outline. The vitellus is coarsely granular. Externally the whole is enveloped in a cellular coating, the follicle, which is composed of rounded or nearly quadrangular nucleated cells. When seen from the surface they are hexagonal or diamond-shaped in outline. A very delicately walled tube, which may be the oviduct, seems to run upwards to the atrium alongside the intestine, and to terminate close to the anus; on the other hand it may possibly be merely a fold of the mantle (see Pl. VII. fig. 7).

Among the smaller ova there may be seen some still smaller triangular or pear-shaped masses of protoplasm with no nuclei, but coarsely granular in texture, which stain strongly with carmine (Pl. VII. fig. 9). It is possible that these may be small spermatic vesicles, and such I believe them to be. If, however, they be merely young ova, then no trace of a testis has been discovered. Probably dichogamy exists here as in some other Compound Ascidians, and the colonies investigated were in their first sexual condition (protogynous), the testes being still in a rudimentary state.

Incubatory Pouch.—This curious organ (Pl. VII. figs. 7 and 12–14) is an appendage to the mantle, in connection with which the structure of its walls have already been described. It is merely an enormous diverticulum of the peribranchial or atrial cavity, in which the embryos lie during their development. It joins the atrium on its dorsal edge (Pl. VII. fig. 7) close to the anus and the termination of the oviduct (?). It has a very narrow neck, barely wide enough to let a mature ovum pass in, and far too small to allow any of the embryos found in the pouch to go back again to the atrium. The problem then is, how do the fully developed larvæ escape? Two methods suggest themselves as possible:—Either (1) they burst their way through the outer wall of the colony, which is not very thick, when the larvæ are fully developed and the incubatory pouch distended to its utmost, or (2) the entire pouch with its contained larvæ remains intact till in the natural course of events, as will be seen shortly (p. 93), it reaches the summit of the colony and is cast off. The larvæ may then be set at liberty by bursting the wall of the pouch or by its decay.

Another curious point in regard to the incubatory pouch is that the embryos at its far end are always the youngest, while those near the neck are generally completely formed tailed larvæ. Now if the ova, as they passed up into the peribranchial cavity, were deposited successively in the pouch, those at the far end would be the most advanced in development, and mature ova or very young embryos only would be found at the neck of the pouch. Thus the observed arrangement is the reverse of what would be naturally expected.[1] If, however, the ova are fertilized successively as they reach the peribranchial cavity, and then remain there for some time—until, in fact, they

[1] The greater part of this account of the structure, &c., of *Colella* was written some years ago. Della Valle has since observed a similar condition of the incubatory pouch and its contained embryos and larvæ in the genus *Distaplia* (*Arch. ital. d. Biol.*, vol. i. p. 193).

have all passed up from the abdomen—and if the incubatory pouch is then formed in such a way that the ova which have been fertilized last pass in first, and so reach the far end of the pouch, then the observed arrangement would be brought about. But I have no reason to believe that this is the actual process, as no Ascidiozooids were found with the peribranchial cavity full of ova and embryos for the reception of which an incubatory pouch had not yet been formed.

The Process of Budding.—As this account is taken from the observation of some chance sections of buds occurring in a few preparations of sliced stems, many gaps of course exist, and many points remain undetermined on account of sections in the proper direction, and at the proper stage of development, not being obtainable. Further study with more abundant material will be required to unite the various links and supply all details.

It has been already seen that from the abdominal region of each Ascidiozooid in the colony a long appendage extends downwards towards the base of the peduncle, that this appendage consists of a blood sinus in direct communication with the posterior extremity of the heart, and of a covering derived from the mantle or body-wall, and that in the peduncle these appendages lie in tunnels bored through, and separated from each other by, the investing mass (Pl. VIII. fig. 9).

These vascular appendages, as might be expected from their nature, contain blood-corpuscles; in the preserved specimens, however, the corpuscles are never very abundant. Throughout the greater part of an appendage they are scattered singly and sparingly; here and there, however, at or below the middle of the stalk, clusters of them may be seen adhering to the walls of the tube. These clusters vary in size from two or three corpuscles up to a dozen or so; in the latter case it may be generally observed that the wall beside them bulges a little outwards, so that they occupy a slight recess (Pl. IX. fig. 2). Probably the corpuscles now begin to divide, at any rate their number increases rapidly, so as to form a more or less spherical cellular mass placed in a diverticulum of the appendage. This is the beginning of the formation of a bud. This mass of cells increases in size and becomes ellipsoidal or almond-shaped (Pl. IX. fig. 3). The cavity in which it lies also enlarges, works its way into the adjacent investing mass, and finally becomes entirely shut off from the tube of which it originally formed a part (see Pl. IX. figs. 4, 5).

Before this migration has taken place the cells of the bud have come to be arranged in two concentric layers (see Pl. IX. figs. 3, 4, 6). How this takes place I was unable to determine. Probably the outer layer is formed from the wall of the vascular appendage (which is covered by an extension of the ectoderm) and the inner by a rearrangement of the blood-corpuscles (usually regarded as mesoderm cells). Two layers, however, are produced, an outer or ectodermic and an inner or endodermic, the latter enclosing a cavity, the archenteron.

The next process revealed by the sections is the longitudinal division of the archenteron into three cavities by the formation of two laterally placed lines of constriction. These cut across the cavity and unite with the opposite wall, separating off two lateral thin-walled spaces from the central much stronger sac (Pl. IX. fig. 7; Pl. VIII. fig. 8).

While this division has been taking place, or possibly before the process began, the neural tube has been formed. Unfortunately none of the specimens throw any light on its origin. This I more especially regret, as from Kowalevsky's observations it appears that in *Didemnium styliferum* and *Amaroucium proliferum* the neural tube is derived from the dorsal wall of the central compartment or mesenteron, an origin which, on theoretical grounds, seems very improbable. It is first observed (in my transverse sections) as a small but thick-walled tube, lying close under the ectoderm in the dorsal region, formed of a single layer of wedge-shaped nucleated cells and having a very small lumen (Pl. VIII. fig. 8). I am inclined to believe (although I have no specimens which prove it) that the neural tube arises, as in the development of the Ascidian from the egg, by the formation of longitudinal dorsal ridges of ectoderm which grow up, arch over, and coalesce, thus forming an ectodermal canal which occupies the dorsal region of the perivisceral cavity (the space between the primitive ectoderm and endoderm, not the future peribranchial cavity).

In sections where the archenteron is completely divided into three cavities the neural canal is always seen. It afterwards increases in size and the lumen enlarges; it also separates farther from the ectoderm and takes up a position nearly equidistant from the two primitive layers, or in some cases nearer to the endoderm (Pl. IX. fig. 8, *n.t.*). The bud as a whole has now grown considerably, and the ectoderm has changed its appearance. The number of cells is much greater, and individually they are longer, having a distinctly columnar form and a yellowish colour.

The three cavities into which the archenteron was divided also continue to increase in size, especially the central one, which is destined to form the alimentary canal, and chiefly the branchial sac. The two lateral cavities are not nearly so large, and their walls are composed of smaller cells. They tend to apply themselves to the outer wall of the central cavity and to curve round its ventral and dorsal edges; eventually they unite at the latter and form the peribranchial cavity or atrium.

An important process may be seen taking place in the ventral region of the primitive branchial sac. Soon after the division of the archenteron, two longitudinal lateral ridges grow inwards along the ventral part of the central division, leaving a deep groove between them. This is the origin of the endostyle. At one time it occupies nearly the whole breadth of the ventral region of the future branchial sac (Pl. IX. fig. 8, *en.*), and the cells of which it is composed are considerably larger than those of the rest of the wall.

Two buds which were cut in longitudinal section show (Pl. IX. figs. 9, 10) a further stage of development, in which three points of interest are seen, viz., (1) the

first appearance of the reproductive organs in the form of a few primitive ova placed dorsally and posteriorly, behind the branchial sac. The mass is of rounded form, and contains several young ova. (2) The formation of the intestine as an outgrowth posteriorly from the large branchial sac (mesenteron). It has the form of a short slightly curved blind tube (Pl. IX. fig. 9, *i*). (3) The union of the two lateral peribranchial spaces dorsally to form the future cloaca (Pl. IX. fig. 10, *p.br.*) Figure 9 represents a stage rather more advanced than figure 10. It shows the rectum leading up to the peribranchial cavity.

After this stage a gap occurs. With the exception of one specimen showing a transverse section through a branchial sac (Pl. IX. fig. 11) in which two rows of stigmata are already formed on each side and in which the endostyle is seen in the form of a pair of parallel folds, there are no further specimens till a stage is reached so far advanced that it can hardly be called a bud. It is a young Ascidiozooid (Pl. IX. fig. 12) with all its organs and four rows of roundish stigmata already formed. Its body is obscurely divided into the two regions of the adult Ascidiozooid, and, from the posterior end of the abdomen, the vascular appendage has begun to bud out. The position and destiny of this young Ascidiozooid will be discussed presently.

The preceding outline of the process of gemmation shows several points of interest, the first of which is the important position occupied by the vascular system in the formation of buds. In this respect, however, the present species does not stand alone, but resembles the Clavelinidæ amongst Ascidiæ Simplices and *Didemnium styliferum* (Kowalevsky), *Sarcobotrylloides wyvillii* and some other forms in the Ascidiæ Compositæ. The division of the archenteron into three longitudinal cavities, the two lateral being destined to form by their union dorsally the peribranchial cavity of the adult, seems to be a phenomenon of very general occurrence in Ascidian buds, and was described long ago by Metschnikoff in *Botryllus* and by Kowalevsky in *Perophora*, *Didemnium*, and *Amaroucium*. No transverse division of the buds such as takes place in *Botryllus* (Metschnikoff and Krohn), *Didemnium* (Kowalevsky), and *Amaroucium* (Kowalevsky) is met with in the present species.

In this case, as in others (see p. 59), I believe that it is possible to trace back the structures which enter into the formation of the bud to the two primary germ layers of the body of the adult Ascidiozooid. The wall of the vascular appendage which probably forms the outer layer of the bud is continuous with the mantle, and is therefore covered by ectodermal cells. The blood-corpuscles which lie in the vascular appendage and form the inner layer of the young bud are mesodermal cells. Now it has been shown by Kowalevsky and by E. van Beneden that in various Ascidians the mesoblast in the embryo is derived from the hypoblast.[1] Consequently the mesoblast cells, which become

[1] See also Seeliger, Zur Entwickelungsgeschichte der Ascidien, *Sitzungsb. d. k. k. Akad. d. Wiss. Wien*, Bd. lxxxv. Heft iv. p. 364, 1882.

blood-corpuscles, may possibly be regarded as supplying the endodermal element to the bud.

The Formation of the Colony.—It has already been stated that buds advanced in development are only met with in the upper part of the stalk, while at the very top the buds are almost in the condition of young Ascidiozooids (such as Pl. IX. fig. 12). These last form a perfectly graduated series with the young Ascidiozooids placed at the base of the head, showing very plainly that the latter are derived from stalk buds. All the middle part of the head is occupied by adult Ascidiozooids in full vigour, no young ones being found amongst them. In the upper part, on the other hand, it is evident that the colony is in a state of decay, gaps being found, and Ascidiozooids in a semi-decomposed condition occurring here and there, while at the very summit of the colony all is dead, no Ascidiozooids are present, and the investing mass is ragged and evidently wasting away (Pl. V. fig. 2).

All this suggests that the following is the probable method of increase and maintenance of the colony. After having been once established, by the development of a tailed larva, it grows from the lower part of the future stalk where the test substance or investing mass alone is produced. As this gets pushed up by the formation of more below it the end of a vascular appendage from the single Ascidiozooid in the head above penetrates down into it and in course of time produces one or more buds. These become imbedded in the investing mass around the vascular appendage, and proceed to develop, occupying, as they advance in age and size, successively higher and higher positions in the young stalk on account of the constant growth at the base of the colony. In this way, when fully developed, they reach the top of the stalk ready to take their places as young Ascidiozooids at the base of the head.

In the fully developed colony the buds are produced near the centre of the stalk, while, when they reach the base of the head, they occupy the outer layer. This change in position is caused by their being pushed outwards as they advance towards the head by the new vascular appendages which are constantly growing downwards from the young Ascidiozooids above them and which occupy the centre of the stalk. Thus the buds are gradually forced into their peripheral position.

After entering the head the young Ascidiozooids continue to grow and soon reach maturity, sending down their vascular appendages through the stalk to form new buds, and producing also tailed larvæ from true ova fertilized by the spermatozoa of the older Ascidiozooids. Still they are constantly being pushed upwards, and finally, after having developed and lived through the entire length of the colony, they reach the summit as old Ascidiozooids, die, and drop off.

In this way it is obvious that the colony when once established may be maintained; while if, as must be the case at first, the production of buds is in excess of the death and decay at the summit, the colony will increase in size.

On the other hand, after a certain period the power of reproducing by gemmation will probably decrease, and, as a result, the colony will dwindle away and finally disappear, new ones being doubtless formed by the free swimming tailed larvæ which escape from the incubatory pouches of the adult Ascidiozooids.

Colella thomsoni, n. sp. (Pls. X.–XIII.).

The Colony is somewhat club-shaped, and is attached by the base of an irregular peduncle which does not increase in size as it is traced upwards. The head, in which the Ascidiozooids are placed, is of an elongated ellipsoidal shape. The surface is smooth. The colour of the head is bluish-violet, of the stalk white.

Size—head 0·9 to 6·5 cm. in length, and 0·7 to 3 cm. in greatest breadth; stalk 7·2 to 13 cm. in length, 8 mm. in average diameter.

The Ascidiozooids are of very large size and are imbedded in the common test. The body of each is composed of thorax and abdomen with a long vascular appendage.

The Test is soft and gelatinous in the head, and considerably harder in the peduncle.

The Mantle is thin, but is fairly muscular.

The Branchial Sac is large, and has many rows of stigmata on each side. The transverse vessels are all of the same size. The stigmata are long and narrow, and are arranged with regularity.

The Dorsal Lamina is represented by a series of long triangular languets.

The Tentacles are eight in number, and are all of the same size.

The Dorsal Tubercle has a simple circular aperture.

The Alimentary Canal is large, and extends for a considerable distance behind the branchial sac.

The Reproductive Organs are not large, and lie alongside the alimentary canal. The testes are well developed; they are arranged in a grape-like manner.

The Incubatory Pouch is small, and is not coiled spirally.

Locality.—Station 212, January 30, 1875; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms; bottom, sand.

About a dozen specimens of this remarkable species were obtained off the south coast of the Philippine Islands, in shallow water. It resembles somewhat in external appearance *Oxycorynia fascicularis*, von Drasche,[1] from the Caroline Islands, and a Compound Ascidian figured by Gould,[2] and named "*Nephtheis* (?)," from the Sulu Sea, but differs from both. Besides other points of distinction, *Oxycorynia fascicularis* has the Ascidiozooids projecting at their anterior ends, while in Gould's species the peduncle is branched and the colour is green.

[1] *Verhandl. d. k. k. zool.-bot. Gesellsch. Wien*, Jahrg. 1882, Bd. xxxii. p. 175.

[2] United States Exploring Expedition, 1856, Mollusca, pl. lii. fig. 621.

Anatomy.

The colony of this species (Pl. X. fig. 1) agrees with that of the last in being more or less club-shaped, but generally shows more resemblance to an elongated head of clover borne on a thickened stalk. The stalk (Pl. X. fig. 3) is of a dirty white colour, is thick, bent, and twisted, and has an irregular surface, generally grooved longitudinally. Compared with the last species it is short in proportion to the size of the head, and instead of tapering downwards rather increases in diameter as it approaches the base, which is a thickened bulb generally covered with adhering sand-grains, shells, zoophytes, &c. (Pl. X. fig. 1), showing that this end was attached or imbedded in the sea-bottom. On account of the curvature of the stalk, the comparatively large head hangs downwards, its apex probably having been close to the ground. The colour of the stalk is the same in all the specimens, and no structure is visible from the outside. The head (Pl. X. figs. 1, 2) is more elongated than in the last species, and is generally thickest a short way from the base; from this point it tapers to the rounded apex. The investing mass is almost perfectly transparent. The Ascidiozooids are seen as dull white elongated patches arranged in spiral lines (Pl. X. figs. 1, 8). They are largest at the upper end of the colony, where, though arranged more openly (Pl. X. fig. 2), they extend almost to the summit, there being little or no bare patch as in the last species. At the base of the head they are smaller and are placed closer together (Pl. X. figs. 3, 7), but the difference in size is usually not very striking.

Almost the entire thorax of each Ascidiozooid is seen (Pl. X. fig. 8), and the two apertures, the sinus over the ganglion, and the endostyle, are easily distinguishable. The Ascidiozooids are placed so that the thorax inclines upwards and outwards (Pl. X. fig. 6), and as the endostyle may be seen running along the outermost edge of the thorax it follows that the atrial aperture and therefore the dorsal side of the Ascidiozooid is next the summit of the colony. The space between the Ascidiozooids seen through the transparent investing mass is of a dull indigo colour: this gives the head its characteristic bluish tint.

As in the last species the Ascidiozooids are arranged round the periphery of the head, the centre of which is occupied by an investing mass traversed by the vascular appendages attached to the posterior ends of the Ascidiozooids. The investing mass of the central region has a hyaline appearance, but is not so transparent as the part occupying the peripheral zone.

The Ascidiozooids are much larger than those of the last species, and are placed more vertically in the colony, in consequence of which they overlap, the abdomen of one being covered by the thorax of the next below (Pl. X. figs. 6, 7). On account of the small size of the incubatory pouch in this species, the embryos do not form a naked eye feature, the whole extent of the sections being occupied by the Ascidiozooids and the investing mass.

In a transverse section of the head three zones may be distinguished (Pl. X. fig. 5). The external one is formed by the transparent outer part of the investing mass in which are imbedded the light grey thoracic regions of the Ascidiozooids. The next or middle zone is composed of the transversely cut abdominal regions of a couple of rows of Ascidiozooids with very little matrix around them. The third or central zone has matrix alone (Pl. X. fig. 5), it is rather opaque, and its texture is spongy on account of the vascular appendages which traverse it.

In a vertical section (Pl. X. fig. 7) the same three zones are recognised. The inclined position of the Ascidiozooids which causes the overlapping is well seen, and it is noticeable that the abdomen is usually more nearly vertically placed than the thorax, thus accounting for the fact that more cut ends of the former than of the latter are seen in a transverse section (Pl. X. fig. 5). In a vertical section (Pl. X. fig. 6) the diminution in the size of the Ascidiozooids as they approach the base is very evident, but nothing resembling buds is visible in the stalk below. At the very base of the head, however, and seen in a vertical section as a sort of incomplete cap or funnel-shaped collar surrounding the top of the stalk where it becomes continuous with the central part of the head, is a narrow zone of buds or very young Ascidiozooids lying internal and posterior to the lowest row of adults (Pl. X. fig. 7), and evidently destined shortly to reach the periphery and appear as young but fully developed Ascidiozooids.

Histology.

Investing Mass or Test.—The matrix of the head, it has been seen, presents itself apparently under two different forms; in the outer thoracic zone it is gelatinous, but solid, homogeneous and transparent, while in the centre of the colony it seems firmer, but is spongy and irregular, being sometimes reduced to a reticulum, and is more opaque, having usually a bluish hyaline appearance. These two parts are, however, identical in structure, the difference in their appearance being due to the presence of the vascular appendages in the inner region of the investing mass.

Comparatively little structure is visible in this test. No bladder cells are present in any part of the colony, and the other cell elements are comparatively few, the great mass of the tissue being homogeneous apparently structureless matrix. The usual fusiform and stellate, and many smaller, nearly circular, test cells are present (Pl. XI. fig. 1, *t.c.*), while here and there another form occurs which may be considered intermediate between the branched test cell and a bladder cell. These are larger than the stellate cells, and are more or less globular or ovate in form; they have a delicate outline from which a few faint hair-like processes radiate outwards like the branches of the stellate cells; the protoplasm does not fill the cell, and it is generally accumulated

at one end around the nucleus, leaving a larger or smaller clear space between it and the cell-wall at the other extremity.

The peduncle is mainly composed of investing mass, and is seen on section to be very spongy in texture (Pl. XIII. figs. 1–4). Large and rather irregular longitudinal canals traverse it in great numbers and throughout almost its entire thickness. These are united by a vast number of smaller vessels which run in horizontal or transverse planes and communicate freely with the larger vessels (Pl. XIII. fig. 2, *v.*). The latter contain the vascular appendages closely attached to their walls throughout, and giving off lateral branches which occupy the smaller canals. Thus a colonial system of blood-vessels is formed, the vascular systems of the different Ascidiozooids being placed in direct communication with one another through the vascular appendages and their lateral branches in the peduncle.

In a transverse section (Pl. XIII. fig. 1) the matrix is seen in the form of a series of islands surrounded by the small horizontal vessels, while here and there (Pl. XIII. fig. 3) the cut ends of the larger vertical vessels are seen. The investing mass, as in the upper part of the colony, contains no bladder cells, only the small spherical, fusiform, and branched test cells being present (Pl. XIII. fig. 4).

Mantle.—Under this head, as in the last species, the shape of an adult Ascidiozooid dissected out from the investing mass will be described first. The body may be divided into two parts, the thorax and the abdomen, the latter of which bears the long vascular appendage. The incubatory pouch in this species is so rudimentary as not to require consideration apart from the peribranchial cavity of which it is merely a portion. The thorax is flattened laterally and has an oblong shape (Pl. X. fig. 9), somewhat narrowing as it recedes from the wide obliquely truncated anterior end where the two apertures are placed. The abdomen is rather long and narrow, and is rounded posteriorly where the vascular appendage projects from it (Pl. X. figs. 9, 10). It is of a dark indigo-blue colour, and gives the deeper part of the colony in which it lies the well-marked characteristic tint. These regions of the body contain the same organs as in the last species.

The mantle covers the thorax, abdomen, and vascular appendage in the form of a delicate sac with two openings, the branchial and atrial siphons. In its structure and the distribution of the musculature it resembles the last species closely. In the thorax, however, the transverse parallel muscle bands are more regular and more frequent, while the longitudinal bands are fewer in number, and in the case of some of the Ascidiozooids almost entirely absent (Pl. X. fig. 10).

The connective tissue elements present no notable peculiarity; a few fusiform and stellate corpuscles are scattered in the homogeneous transparent membrane connecting and surrounding the muscle fibres. The mantle is lined on its inner aspect with the usual layer of squamous epithelium, which is often distinctly visible in this species without any staining (Pl. XI. fig. 4). The ectoderm on the outer surface is in its

normal condition. The muscular siphons of the two apertures closely resemble those of the last species, both in appearance and minute structure.

The transverse muscle bands are very strong (Pl. X. fig. 10, and Pl. XI. fig. 3), each being composed of several parallel bundles of fibres, and they are placed so closely that they must form a powerful ejaculatory apparatus when suddenly contracted. On the right side of the thorax, these strong circular muscle bands do not extend so far down as to cover the part of the peribranchial cavity which represents the incubatory pouch. Probably this is to prevent the expulsion of embryos before they are ready; while, when developed and fit to leave the maternal atrium, they have advanced into its anterior muscular part. Over the endostyle in the ventral median line the circular bands break up, interlace, and unite with portions of neighbouring bands so as to form a reticulum in that region (Pl. XI. fig. 3).

Branchial Sac.—In this species there is no indentation on the ventral border, the sac having an oblong or somewhat pyriform outline (Pl. X. fig. 10). Its structure is simple, being formed of transverse and small longitudinal vessels, with the addition of internal transverse vessels (or horizontal membranes) which run round the inside of the sac, one at the level of each transverse vessel, and are connected at the ends with the dorsal and ventral trunks. They are of small calibre, rather thick walled, and covered externally with short cilia, and are distinctly seen when the sac is viewed from the inside (Pl. XI. fig. 5, *h.m.*).

The stigmata which lie between the longitudinal vessels are of small size but very numerous, and have the form of elongated ellipses (Pl. XI. figs. 5, 9, 10). There are in the adult sac from twelve to eighteen (usually about sixteen) rows on each side, and an average of forty stigmata in each row, making about twelve hundred stigmata (six hundred on each side) in the entire sac. The walls of the vessels have the usual structure, but the ciliated cells surrounding the stigmata are often of a slightly different form from those already described. They are not so pointed as the conical form in the last species, being more globular or quadrangular and often not showing much difference between the attached and the free ends (Pl. XI. figs. 6, 7); the barrel-shaped kind do not occur in this species. The nuclei are distinctly circular in outline and are placed nearer to the attached than to the ciliated end of the cell.

The Endostyle has the usual structure. It extends in a single curve from the branchial aperture along the ventral margin of the branchial sac to the posterior end. Seen from the ventral or dorsal aspects (Pl. XI. fig. 8) it is nearly straight, not being thrown into a series of curves as in the last species. Viewed from the side (Pl. XI. fig. 2), its posterior extremity is seen to turn dorsally, nearly at right angles to its former course, and extend for a short distance in the direction of the œsophageal aperture. The minute structure of the endostyle is similar to that of the last species.

The Dorsal Lamina is represented by a series of large flat triangular processes or

languets, which are attached to the muscular band running along the dorsal edge of the branchial sac. This band is seen best from the outside, and is of considerable breadth. A languet springs from it at its intersection with each of the transverse vessels of the sac (Pl. XI. fig. 9). Each languet has the form of a greatly drawn out isosceles triangle, and at the base its edges are in connection with the ends of the internal transverse vessels running along the inner surface of the branchial sac (Pl. XI. fig. 10). The edges of the languet are composed of columnar cells bearing short cilia, continuous with those on the internal transverse vessel. The languets are about 0·2 mm. in length, and are generally thrown into one or more curves. The rather blunt apex of each extends to the base of the next below, and sometimes beyond it, when they are placed pointing posteriorly.

Tentacles.—Eight is the normal number of tentacles in this species, but seven and nine have been also observed. They are all of the same length, and are placed in a circle in the usual position anterior to the peripharyngeal band (Pl. XII. figs. 1, 2). They are rather shorter and stouter than those of the last species and are placed much closer to the peripharyngeal band, but are otherwise very similar in appearance and minute structure.

The Peripharyngeal Band requires no special description, as in structure and relations it exactly resembles that already described in the last species. The same may be said of the prebranchial zone and the ciliated band at the base of the tentacles, but a structure placed above or anterior to the tentacular circlet requires a short notice. It presents the appearance of a number of curiously shaped tentacles of different sizes arranged in a circle and directed outwards so as to meet and be overlapped by the true tentacles (Pl. XII. fig. 1). They form a series of irregular finger-like processes depending from the edge of a zone-like thickening of the mantle near the base of the siphon, and forming a sort of rudimentary diaphragm (Pl. XII. fig. 2). A similar structure is seen at the base of the atrial siphon, where, however, it is more rudimentary, being present only as a thickened undulating line (Pl. XII. fig. 3).

Neural Gland and Dorsal Tubercle.—Here, as in the last species, these obscure organs are difficult to distinguish on account of their opacity. On the ventral and anterior surfaces of the nerve ganglion there is a small oval or pyriform opaque yellowish-brown body (Pl. XII. fig. 1), which is, there can be little doubt, the neural gland. Continued from its anterior end towards the circlet of tentacles is a somewhat conical or funnel-shaped opaque body with the wider end anterior. Its walls in an optical section are seen to be formed of columnar cells, and the interior is occupied by large cilia pointing posteriorly. This is the neural duct, and its anterior end seems to be a simple circular aperture as in *Colella pedunculata.*

The Nerve Ganglion is of small size and is elliptical in shape. It is placed nearer to the branchial than to the atrial aperture (Pl. XII. fig. 3), and gives off nerves at its ends.

Alimentary Canal.—The abdominal part of the alimentary canal is very opaque, being of a dark indigo-blue colour. This gives the colony its peculiar tint, and it is caused by the blood-corpuscles, which are nearly black, being collected into small clumps which fill the large sinuses extending through the mantle.

The œsophageal opening, placed at the posterior end of the branchial sac, near the dorsal margin, is of large size, and has the edge and its inner surface for a short distance down thrown into a remarkable series of folds, presenting curiously complicated ridges and tooth-like processes (Pl. XII. fig. 4). The œsophagus is short and wide, and opens into the slightly larger stomach, which is continued without much diminution in size into the intestine, the first portion of which forms with the stomach and œsophagus a slightly curved antero-posterior line. The intestine having reached the posterior end of the abdomen, turns sharply round and runs forward parallel to the stomach; then curving upwards, crosses the anterior part of the œsophagus, and after a short rectal course through the peribranchial cavity, ends in a rather prominent anus, the margin of which is disposed in a series of regular folds (Pl. XII. fig. 4). The stomach is not plicated, and there is no typhlosole in the intestine (Pl. XII. fig. 8).

Vascular System.—The heart is placed on the right side of the body in the abdominal region, and lies in the elongated space between the stomach and the intestine. It is a long fusiform undulating tube with very thin walls, which are seen under a high power to contain closely placed transverse fibres which sometimes exhibit a fine cross striation, and are circular in section. Outside this muscular coat is a thin layer of connective tissue, consisting of a delicate membrane in which fusiform and branched corpuscles are imbedded.

Reproductive Organs.—The genital glands are situated on the left side of the abdomen (Pl. XII. fig. 6), to which they are more closely applied than in the last species. In this case the male organs greatly predominate. A large number of oval or pyriform pale yellow vesicles with granular contents are scattered over the surface of the intestine. These are the spermaria or testes. They are in connection with short and fine ducts which unite into about a dozen larger ones, and these converge towards and open into the lower end of a large opaque yellowish-brown vas deferens, which runs up the inner edge of the intestine towards the atrium (Pl. XII. figs. 6, 7).

Usually in the adult Ascidiozooid no ovary is visible (Pl. XII. fig. 6). Rarely one or two large ova are seen among the testes, and more frequently one, two, or three mature ova are found occupying different positions on their way to the atrium (Pl. XII. fig. 6). In young Ascidiozooids, however, from the base of the colony (see p. 96), the ovary is well developed, and exactly resembles that of the last species (see Pl. XII. fig. 8). These circumstances seem to indicate the existence of protogyny, each Ascidiozooid being first female and then male, and the ova of those near the base being fertilised by the spermatozoa of the older ones farther up the colony. An Ascidiozooid such as the one

represented in figure 6 is just ending its female stage of existence and preparing to function as a male.

Incubatory Pouch.—In the present species this organ is so slightly developed that it is doubtful whether it should be considered as existing at all. The embryos merely lie in an enlargement of the base of the peribranchial cavity.

On examining the thorax of a fully developed Ascidiozooid from the right side, two, three, or four large mature ova are noticed, forming a transverse row, which extends from the dorsal edge three-fourths of the way round the posterior end of the thorax towards the endostyle (Pl. XI. fig. 2). Generally the dorsal end of the row projects more or less beyond the margin of the thorax, and is then contained in a sac-like diverticulum of the mantle, having no muscular bands. From the ventral end of this transverse row of ova a series of embryos in different stages of development extends in an oblique antero-posterior direction from the base of the endostyle towards the atrial aperture. The most posteriorly placed of these is only slightly more advanced in development than the ovum next it, while the embryo at the anterior end of the line is a tailed larva ready for expulsion (Pl. XI. fig. 2). Thus a regular series is formed from the dorsal end of the sac across the posterior end and then along its length to the atrial aperture, the embryos being arranged in order of development. These series of ova and embryos merely lie in the peribranchial cavity, and are covered by the mantle, which they push out so as to form a sac-like diverticulum, which only differs from the incubatory pouch of the last species in degree of development and in not being so much constricted off from the rest of the peribranchial cavity. This arrangement rather supports the view (suggested on p. 89) that in *Colella pedunculata* the incubatory pouch may possibly be formed after the ova and embryos have all arrived in the peribranchial cavity. It is obvious that if in *Colella thomsoni* (see Pl. XI. fig. 2) the region of the peribranchial cavity occupied by embryos were constricted off to form an incubatory pouch commencing with the posterior end of the dorsal edge, the youngest embryos would be placed at the far end of the pouch and the tailed larvæ would be next the mouth—exactly the arrangement found in *Colella pedunculata*.

The Process of Budding.—In this species, as in the case of *Colella pedunculata*, gemmation takes place in the peduncle. The vascular appendages have the same structure as in the last species. Each is divided by a median septum into two canals running side by side. The wall is formed of squamous epithelium, the ectoderm, lined by a delicate layer of connective tissue. The ectodermal cells are polygonal and distinctly nucleated (Pl. XIII. fig. 5). These vessels and their lateral branches contain many blood-corpuscles —in some places the small vessels, and especially some short cæcal processes which occur on their sides, are completely filled up with them (Pl. XIII. figs. 1, 4). Every here and there in the cavities of the vascular appendages occupying the larger canals of the stalk minute buds or spherical aggregations of cells are found (Pl. XIII. fig. 8 *gm'*).

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These are from 0·02 to 0·06 mm. in diameter, but no larger (see Pl. XIII. fig. 1). They are of a yellowish-brown colour, and so opaque that no structure can be made out in their interior. The method of formation of these young buds was not directly observed, but in all probability they arise as in the case of the last species by the aggregation and proliferation of a number of the blood corpuscles surrounded by an ectodermal layer derived from the wall of the vascular appendage. The only specimen showing a stage in the early formation of a bud is the one represented in figure 9, where an outer layer of cells is seen separating off from the ectodermal wall of the vessel (*ec.*), while the free mesoderm cells inside are becoming arranged along the wall and in some places are proliferating. Some of these cells have become enlarged (*o.*) and already look like the ova which they become later on. Just as in *Sarcobotrylloides wyvillii*, young ova are conspicuous in the bud from a very early period (Pl. XIII. figs. 7, 8).

In transverse sections of the stalk, until the very top is reached, no further development of the buds is seen except a slight increase in size. Just below the head, however, there is a narrow zone where buds are found in various stages of development from the simple spherical double-walled sac up to the young Ascidiozooid (Pl. XIII. figs. 7, 8). The course of development is apparently the same as in the last species. Sections showing the archenteron divided into three, the dorsal nerve tube, the ventral endostyle, the posterior ovary, and lastly the elongation of the abdominal region may all be seen. It is remarkable, however, that the earlier stages, showing the division of the archenteron and the formation of the endostyle, which were those most commonly seen in sections of the peduncle of the last species, are here much rarer than the later stages, where the ovary and intestine have made their appearance (see Pl. XIII. fig. 7).

The buds in this species seem to remain, when in the condition of two membranes surrounding an archenteron, in a dormant condition undergoing no change except a slight increase in size, until they have reached the top of the stalk, where they rapidly pass through the stages of their development which had been delayed, and appear in the form of young Ascidiozooids (Pl. XIII. fig. 10) which then continue to grow slowly in size until they arrive at the base of the head. This course of development would explain the comparative rarity of buds in the earlier stages, which were passed through more rapidly. In some cases the buds do not become completely constricted off from the vessels as in *Colella pedunculata*, but remain attached by their posterior ends up to a late period in their development (see Pl. XIII. fig. 8). Figure 10 shows a young Ascidiozooid in which all the chief systems of the body, including the genital glands (*ov.* and *t.v.*), and even the digestive gland (*h. gl.*) on the intestine, are already present.

The Formation of the Colony.—In this species the colony seems to be more stable and to undergo change less rapidly than in the case of *Colella pedunculata*. This may be inferred from the observed facts, that the Ascidiozooids are more of the same size, the differences between those at the opposite ends of the head not being very great; that

there is little or no bare patch at the summit of the colony, suggesting that the Ascidiozooids are rarely cast off; and lastly, that there is not such a complete gradation between the buds at the top of the peduncle and the young Ascidiozooids at the base of the head. The buds are not produced in such numbers, and they probably go through their development as a whole more slowly than in the last species. The young Ascidiozooids added to the base of the colony will therefore be fewer in number, and will occur at rarer intervals. Each Ascidiozooid in the head will live longer, and the death and decay of those at the summit will not occur so frequently. This of course only applies to a colony in a full grown and flourishing condition. When young the budding will no doubt be more rapid; and when old the death of the Ascidiozooids and the decay of the colony will certainly increase greatly in its rate, and be accompanied by a diminution in, or entire stoppage of, the process of gemmation.

Colella gaimardi, n. sp. (Pl. XIV. figs. 7–14).

The Colony has the form of a more or less rounded mass, the head, attached by a peduncle. The head is usually flattened in one direction. The peduncle tapers downwards slightly to the point of attachment. The colour is dull yellow, passing in some parts into drab or brown. The surface is even and moderately smooth. No common cloacal apertures are visible.

The length of the head is 9 mm., the breadth 10 mm., and the thickness about 5 mm.

The length of the peduncle is about 2 cm., and the thickness at the middle about 2 mm.

The Ascidiozooids are elongated antero-posteriorly, and are rather large, usually about 3 mm. in length and 1·5 mm. in greatest breadth. They are not arranged regularly. The abdomen is large and has a rounded posterior end from which a vascular appendage is prolonged through the common test.

The Test is soft and gelatinous. The outer layer on the head is firmer and has a smooth glistening outer surface. It is very transparent. The homogeneous colourless matrix is crowded with cells of various sizes and shapes. A few very small bladder cells are present, but no pigment cells.

The Mantle is fairly strong. The musculature is regular and well developed. It consists mainly of transverse bands.

The Branchial Sac is delicate. The transverse vessels are rather narrow and are all of the same size. The stigmata are long and narrow.

The Dorsal Lamina consists of a series of short pointed languets.

The Tentacles are very short. There are eight, and they are all of the same size.

The Alimentary Canal is large.

The Reproductive Organs are not very conspicuous. A large incubatory pouch projects from the dorsal edge of the peribranchial cavity.

Locality.—Port William, Falkland Islands; January 27, 1876; depth 5 to 10 fathoms.

Four large colonies and one very young one are included in this species. They were obtained at Port William, on the eastern coast of the Falkland Islands, from a depth of 5 to 10 fathoms.

The above description and measurements were taken from three of the larger specimens. The fourth differs slightly, but is not sufficiently distinct to be placed in a separate species. The head is larger and flatter, so as to be somewhat discoid, but its lower end is broader than the upper, and has a truncated appearance. The exact dimensions are as follows:—Length of the head 13 mm., breadth 16 mm., average thickness 4 mm. Length of the stalk 18 mm., thickness at the upper end 3·5 mm., at the lower end 1 mm. The colour in this specimen is rather paler than in the other three, the head being yellow with no tinge of brown, and the peduncle a clear light grey, except the point of attachment, which is slightly brownish.

The very young colony consists of a peduncle about 8 mm. long, and a rounded head scarcely 2 mm. in length and about 1·5 mm. in breadth.

In all the specimens the form of the colony is club-shaped (Pl. XIV. fig. 7), and the peduncle tapers from the base of the head to the point of attachment. There is a certain amount of variability in regard to the lateral compression and also in the position of the broadest part of the colony. The peduncle is always of a lighter colour than the head, and is much greyer than the peduncle of *Colella pedunculata*.

The Ascidiozooids are very distinct; they are large and are closely placed. They appear as opaque yellow spots which may be as much as 2 mm. in greatest diameter (Pl. XIV. fig. 7). This is not the anterior end alone; on account of the irregularity in the position of the Ascidiozooids, a considerable part of the body in many cases shows through. There seems to be no regular arrangement of the Ascidiozooids in lines or groups, and they are not imbedded in the test at right angles to the surface of the colony, but lie inclined at various angles. In transverse sections they are seen to occupy nearly the whole of the interior of the head, there being no central free region of the test. The size of the Ascidiozooids varies greatly. The broadest part is generally where the stomach is placed. The vascular appendage is long and narrow. In the younger Ascidiozooids (see Pl. XIV. fig. 12) it is about twice the length of the body. Its lower end is rounded and usually a little swollen, forming a knob.

The cells in the test are extremely numerous and of fairly large size (Pl. XIV. fig. 9, *t.c.*). Their processes are in some cases very long and branched. The mantle has its muscle bands mainly transverse in direction.

The branchial sac is thin-walled and readily torn. The stigmata are large with narrow ends (Pl. XIV. figs. 8, 11, *sg.*). There are at least four rows on each side of the sac.

The endostyle is fairly straight. It is conspicuous. The languets are very short, and they are not united by a membrane in the middle dorsal line (see Pl. XIV. fig. 11, *l*); the stigmata pass in a continuous series from the one side of the branchial sac to the other across the dorsal edge.

The tentacles are remarkably short. They are merely small triangular stumps and seem to be in quite a rudimentary condition. They form a marked contrast with the well-developed tentacles of other members of the genus, such as *Colella pedunculata*.

The nerve ganglion and neural gland form an ellipsoidal mass, with an anterior prolongation, the neural duct, which opens just inside the prebranchial zone by a simple aperture, the dorsal tubercle.

The alimentary canal is large and conspicuous. In the young Ascidiozooids, of which there are a great many in the colony, it is much elongated antero-posteriorly (see Pl. XIV. fig. 12). The œsophagus in the figure is rather larger than in most of the other specimens examined, but it is always of considerable length. The stomach is oval in shape, and along with the œsophagus runs directly backwards, forming the dorsal part of the visceral mass. After the stomach comes a short and very narrow piece of intestine which usually has a small posteriorly directed cæcal process (Pl. XIV. figs. 12, 13). This forms the termination of the visceral mass. Figure 13 shows the shape of this region of the canal in another specimen. The intestine then enlarges (Pl. XIV. fig. 13, *i.*), and turning anteriorly runs forward to cross the œsophagus, and thus enters the dorsal part of the peribranchial cavity. The ventral part of the visceral mass is formed by the long intestine. In the older Ascidiozooids the alimentary canal is not so much elongated as in the younger ones, the stomach is more globular, and the intestine is relatively shorter and wider. The vascular appendage arises rather on the ventral edge of the posterior end of the abdomen (Pl. XIV. fig. 12, *v.ap.*).

In the intestinal loop, and just alongside the stomach, a number of small ova, forming a compact mass, are always found in the young Ascidiozooids (Pl. XIV. fig. 12). In older ones one or two large mature ova are generally still present, but in addition there are always some ovate opaque seminal vesicles and a vas deferens. In most of the mature Ascidiozooids the dorsal part of the peribranchial cavity is prolonged into an incubatory pouch of considerable size (Pl. XIV. fig. 10). It is usually sac-shaped, with a very narrow mouth, and was never observed to be spirally coiled. These incubatory pouches are filled with embryos in various stages of development, and a large number of tailed larvæ are also present. In the larvæ (Pl. XIV. fig. 14) the body is narrow and elongated, and the tail is very long, being in some cases capable of being wound nearly twice around the body. A very broad delicate membrane fringes the tail upon each

side, but does not seem to have any supporting transverse fibres such as are present in some Ascidian larvæ. The single pigmented sense organ of the larva is placed very far back in the body.

Colella pulchra, n. sp. (Pl. XV. figs. 1–13).

The Colony has the form of a somewhat elongated mass, the head, borne on the summit of a long narrow peduncle. The head is not flattened laterally, and its upper end is usually rather wider than the lower, which tapers into the top of the peduncle. The widest part is about the middle of the head. The peduncle is thickest at the top, where it joins the head, and from that point tapers downwards to the point of attachment, where it usually expands again slightly. The surface is even and smooth. The colour is a dull red. The peduncle is rather paler than the head.

The length of the head is 10 mm., the greatest breadth or thickness 4 mm. The length of the peduncle is about 2·5 cm., and its thickness about the middle 0·5 mm.

The Ascidiozooids are small, less than 1 mm. in length. They are slightly elongated antero-posteriorly, and are placed nearly at right angles to the surface; they incline somewhat inwards and downwards towards the base of the colony. They are arranged in regular vertical rows, which are more or less distinctly placed in pairs.

The Test in the head is soft and gelatinous, that of the peduncle is firmer. The transparent homogeneous matrix contains bladder cells of moderate size, and also the usual small fusiform and stellate cells. The latter are not numerous. The test is to a very great extent occupied by the Ascidiozooids and the embryos, which are numerous and closely placed.

The Mantle is very delicate. The muscle bands are very thin, and they are not numerous. They run chiefly in a transverse direction over the thoracic region of the body.

The Branchial Sac is short, and of a more or less quadrangular form. The transverse vessels are moderately wide, and are all of the same size. The stigmata are long and narrow, they are regularly arranged. The ciliated cells bounding them are convex at their free ends.

The Dorsal Lamina is formed of a series of short blunt triangular languets.

The Tentacles are about twelve in number. They are long and narrow.

Locality.—Station 187, September 9, 1874; lat. 10° 36′ S., long. 141° 55′ E.; depth, 6 fathoms; bottom, coral mud.

About a dozen specimens of this beautiful little species were dredged in Torres Strait between Australia and New Guinea, from a depth of 6 fathoms. The dimensions given above are those of the largest colony. An average sized one has the head about 7 mm.

long and 3 mm. broad. The youngest specimen (Pl. XV. fig. 2) consists of a stalk about 2 cm. in length, bearing at its upper end an elongated thickening in which there are some young Ascidiozooids, especially at the top, where a fairly complete ring is formed by six or seven of them. This colony has scarcely any colour, the entire peduncle and the greater part of the young head being of a pale grey. The Ascidiozooids show as small dull red spots. The next youngest colony has an ovate head with the narrower end downwards. It is 5 mm. long and 3 mm. bread at the widest part, the peduncle is about 2 cm. in length. The head is not of such a dark red colour as in the other specimens, and the Ascidiozooids are smaller.

The other colonies seem mature, and have all much the same appearance (Pl. XV. fig. 1). The head is always much longer than broad, and is not compressed laterally. The top is wide, and has in some cases a truncated appearance. The lower end is narrow, and tapers to the top of the peduncle. The general red colour of the head is seen on a close examination to be due mainly to the bodies of the Ascidiozooids, which are seen plainly as little rounded spots about 0·5 mm. in greatest diameter. They are placed closely side by side in vertical rows (Pl. XV. fig. 1), of which there are usually ten to twelve in a head. Towards the lower end of the rows they become gradually smaller and smaller, while at the top they are full size. Each Ascidiozooid has upon its anterior end a minute white speck of pigment just visible to the eye, and here and there, between the rows of Ascidiozooids, larger masses of white pigment are to be seen.

Under a low power of the microscope (40 diameters) it is clearly seen that the test is of a greyish colour, while the Ascidiozooids are red. The branchial apertures are distinctly visible, and around each may be traced the elliptical peripharyngeal band (Pl. XV. fig. 6, *br.*). The mass of white pigment is now seen to be placed on the anterior extremity of the endostyle, and the rows are clearly seen to be placed in pairs, the Ascidiozooids in each pair having their endostyles turned towards one another, while their dorsal edges are next the space between that row and the adjacent one (Pl. XV. fig. 6). In each row also the Ascidiozooids are placed semi-alternately and lie obliquely, so that their ventral edges are nearest to the base of the colony.

The peduncle is clearly seen to be formed by a central axis of a dull red colour enclosed by an outer layer of transparent grey test (Pl. XV. fig. 9). Here and there the red axis seems broken up into pieces, and, in some places, minute rounded spots of a darker red are present. In sections (Pl. XV. fig. 11) it is seen that the peduncle consists of a continuation of the test, and it has a thin external layer which is homogeneous and firm. Inside this comes a broad zone containing very many bladder cells, while the central region is more solid again, but has numbers of large pigment cells of various sizes and shapes, and here and there a young embryo (Pl. XV. fig. 11, *em.*). It is this central zone which appears red from the exterior, and its colour is due to the numerous pigment cells scattered through it (see Pl. XV. figs. 9, 10, 11). The embryos, either singly or in

groups, cause the irregular appearance of darker red spots in the axial portion. Throughout all parts of the peduncle (Pl. XV. fig. 11) the ordinary minute test cells are found in the otherwise homogeneous matrix. A few thin-walled vessels (Pl. XV. fig. 11, *v.ap.*) are also to be seen in both transverse and longitudinal sections. They traverse the peduncle in its length (Pl. XV. fig. 9, *v. ap.*), and seem to give off no lateral branches.

The Ascidiozooids are decidedly small (Pl. XV. fig. 7). The visceral mass is a little larger than the branchial part of the body. The vascular appendage is delicate, and springs from the middle of the posterior end of the body. It is clearly divided into two tubes running side by side. The anterior end of the Ascidiozooid is not large. It bears the short wide branchial siphon. The dorsal edge of the branchial part of the body is more convex than the ventral.

The test in the head is very soft. As the Ascidiozooids and embryos are very numerous, the test is greatly broken up. There is no large central part of the colony formed of test alone. Bladder cells are abundant, but they are nearly always spherical, not being so numerous as to be compressed into polygonal forms. The ordinary small cells of the test are abundant and of all shapes. The vascular appendages, which are found every here and there in the test, are thin and delicate. They are usually filled with blood-corpuscles.

The musculature of the mantle is very fine. In addition to the regular transverse bands there are some bundles of fibres crossing the others irregularly. There is a good deal of white pigmentation in the mantle. In addition to the patch at the anterior extremity of the endostyle, there are sometimes clumps of cells scattered over the branchial region, and almost invariably there are large areas of the stomach (Pl. XV. fig. 7, *st.*) and intestine which have a granular opaque white appearance from the presence of numerous pigment cells.

The branchial sac is nearly as broad as it is long. There are usually four or five rows of stigmata on each side. The transverse vessels (Pl. XV. fig. 3, *tr.*) are moderately wide; they have delicate horizontal membranes attached to their inner edges. The sac shown in figure 5 was probably not from a mature Ascidiozooid. The stigmata are relatively short and rounded, and all the parts are small. Figure 3 shows the shape of the stigmata in a fully developed condition. The stigmatic cells are very conspicuous under a high power. They are short, and their free ends project usually in a somewhat triangular form (see Pl. XV. fig. 4). The cilia are abundant.

The dorsal languets are rather blunt at their ends. They have more of a triangular form when seen from above or below than from the side as in figure 5. A strongish band of muscle fibres may be traced along the dorsal line of the branchial sac outside the base of the languets (Pl. XV. fig. 5, *d.l.*). The tentacles are long and thin. In several of the Ascidiozooids they were found projecting through the mouth of the branchial siphon

when the test was removed. The endostyle is conspicuous. Its ends are bent abruptly in a dorsal direction (Pl. XV. fig. 7, *en.*).

The alimentary canal is large and conspicuous (Pl. XV. fig. 7). The œsophagus commences at the dorsal edge of the posterior end. It is a short and wide tube, and leads directly backwards to the large globular stomach, which is opaque and thick walled but perfectly smooth, having no ridges or folds. From the dorsal edge of the stomach, near its posterior end, there projects a small pyriform body (Pl. XV. fig. 7, *ap.*). This is seen, when more highly magnified (Pl. XV. fig. 8), to be a short knob-like vascular appendage from the mantle over the stomach, or just where the stomach joins the intestine. It is thin walled, but always contains a number of large pigmented blood-corpuscles of a red colour. The blood-corpuscles all over the body are of a reddish colour, and thus give the Ascidiozooid and the whole colony the characteristic red tint, but the corpuscles in this vascular appendage always seem larger and redder than elsewhere. What the use of this structure is I am unable to say. The intestine springs from the posterior end of the globular stomach and turns at once ventrally and then forwards in a curve which gives the posterior end of the body its rounded shape (Pl. XV. fig. 7). The rectum crosses the œsophagus to gain the dorsal side of the peribranchial cavity. The intestine is wide throughout its whole course.

The reproductive organs lie alongside the intestine, and project on the one hand into the intestinal loop and on the other beyond the intestine ventrally (Pl. XV. fig. 7, *ov.*). They are hermaphrodite in the mature Ascidiozooids, consisting of one or two large ova and a number of spermatic vesicles. Many embryos in various stages of development, and some tailed larvæ, were found in the common test, but no incubatory pouches were observed.

Figure 12 shows one of the most advanced larvæ which were found in the colony. The shape of the body is elongated, rounded at both ends, and widest in the middle. The tail is still present, but the branchial sac is well developed, three or four rows of stigmata being visible. At its front end the larva is provided with two large adhering papillæ. The endostyle is conspicuous and is directed transversely to the longitudinal axis, the future mouth being placed in the middle of the dorsal surface of the larva. The pigmented eye is conspicuous behind the mouth at the one end of the dorsal edge of the branchial sac, while the urostyle begins at the other end close to the œsophageal aperture. The œsophagus bends ventrally to open into the stomach, which lies directly behind the branchial sac. The intestine first runs ventrally, then turns posteriorly, and then curves round dorsally and a little anteriorly, and disappears behind the stomach. The test is well developed all over, and contains a large number of bladder cells.

Figure 13 represents part of another far advanced larva more highly magnified. The endostyle (*en.*) is a conspicuous curved body bounding the branchial sac ventrally. The branchial sac is well developed, and shows four rows of stigmata. At its anterior

end the young tentacles are seen, and in front of them *br.si.* points to the ectoderm in the region of the future branchial siphon. This indicates the anterior end of the Ascidian and the middle of the dorsal surface of the larva. Outside the ectoderm (*br.si.*), the test (*t.*) with its numerous large bladder cells is seen. A single sense organ is present, and is still large and well developed (*ot.*). Around it and between it and the tentacles are some masses of cells (*c.m.*), which are probably nervous. Behind the sense organ (nearer to the posterior end of the larva) is a distinct opening (*ap.*) through both test and ectoderm. The character of the ectodermal cells changes greatly at this point. Over the sense organ they are almost squamous, but as they approach the opening they become gradually cubical and then low columnar in form; finally, where they turn inwards to line the short tube leading from the aperture (see Pl. XV. fig. 13, *ap.*), they become tall, narrow, columnar cells. On the other side of the opening the same changes are seen, the flattened ectoderm cells of the posterior end of the larva becoming first cubical and then columnar. Probably this invagination of the ectoderm at the dorsal edge of the anterior end of the Ascidian is the origin of the atrial aperture. Further back, along the dorsal edge of the branchial sac, is seen the base of the urostyle (*u*), which is continued out into the tail, while still further back is found the œsophagus (*œ.*) leading into the globular thick-walled stomach (*st.*). This larva is very remarkable on account of the advanced state of its organisation while still in a completely larval condition. The branchial sac, the endostyle, and the alimentary canal are well developed, while the urostyle, the pigmented sense organ, and the larval adhering papillæ are still present.

Colella elongata, n. sp. (Pl. XVI. figs. 1–7).

The Colony is elongated and rudely conical. It is not flattened, and is probably attached by a stalk springing from the posterior wider end. The upper free end is narrow, but rounded. The surface is rather uneven, but fairly smooth. No common cloacal apertures are visible. The colour is a dull yellowish-grey, darker towards the lower and lighter towards the upper end.

The length is 3 cm., the greatest breadth is 1 cm., and the thickness about 1 cm.

The Ascidiozooids are elongated antero-posteriorly, and placed at right angles to the surface. They are usually about 1·5 mm. in length and 1 mm. in breadth. The anterior end is broad, and bears both the apertures. The posterior is narrower, and is continued into the long narrow vascular appendage, which, turning downwards, traverses the common test to the base of the colony.

The Test is soft. Its outer layer is smooth and firmer than the deeper parts, which are very soft and spongy. It is not very transparent, and has a greyish colour. In sections

the homogeneous matrix is seen to be occupied by very numerous cells of small size and various shapes. No large bladder cells or pigment cells are present.

The Mantle is fairly strong. The musculature is well developed. The bands are somewhat irregular in their course, but are mostly transverse.

The Branchial Sac is rather short and wide. The stigmata are few but very large; they are long and narrow, with parallel sides and rounded ends. The cells bearing the cilia are short and prominent.

The Endostyle is conspicuous. It has a very irregular course, taking a number of undulations dorso-ventrally.

The Tentacles are numerous and closely placed. There are at least sixteen large ones and the same number of smaller ones placed alternately.

Locality.—Port Jackson, Sydney, Australia; depth, 30 fathoms.

This species is founded for the reception of a single damaged specimen obtained in Port Jackson from a depth of 30 fathoms. Probably the colony was attached by a stalk (whether long or short there is no means of determining) springing from its lower and wider end. What remains of the colony is an irregularly conical body, tapering upwards from a point a little way above the base (Pl. XVI. fig. 1). This is the widest part; below it the body rapidly narrows to the place where it has been torn from its stalk. The breadth and the thickness are in most parts of the colony very much the same. The general shape is more like that of *Colella thomsoni* than of *Colella pedunculata*, but is narrower and more elongated than either of them. The upper part is narrow and tapering. Its end is rounded (Pl. XVI. fig. 1). The surface is smooth and glistening at the top, but becomes more irregular and rougher towards the base of the colony.

The Ascidiozooids are visible on the surface as small light grey opaque marks about 0·5 mm. in diameter. They seem to be scattered quite irregularly over the surface (Pl. XVI. fig. 1). They are equally abundant all over, except on the lower one-fourth or so of the colony, where they are fewer in number than elsewhere. In a transverse section across the middle of the colony (Pl. XVI. figs. 2, 3), the Ascidiozooids are seen to occupy a zone about 1·5 mm. in depth round the outside, while the central part is formed by the colonial test penetrated by the very conspicuous vascular appendages.

The breadth of the Ascidiozooid varies from half to two-thirds of its length. The branchial region (thorax) is generally rather larger than the visceral (abdomen). The anterior extremity is much broader than the posterior (Pl. XVI. fig. 5). The branchial aperture is placed near its middle, while the atrial siphon extends outwards from its dorsal end. The vascular appendage, which springs from the posterior end of the abdomen, is very long, and nearly as wide as the intestine (Pl. XVI. fig. 3). After leaving the body it runs for a short distance towards the centre of the colony, but very soon turns downwards in the direction of the stalk, so that in any section through the

middle of the colony only the upper ends of the appendages belonging to the Ascidiozooids in that section are seen. The remainder of these appendages would appear in sections further down the colony in the direction of the stalk.

The test, considering its soft and unmodified condition, is very untransparent. This is possibly due to the presence of the numerous opaque vascular appendages which run through it. Figure 4 in Plate XVI. shows the number present in a small piece of test from the middle of a section. The cells in the test are extremely abundant. The matrix, though generally homogeneous, is in some places distinctly fibrillated. Small spherical bladder cells are present in some places.

The mantle musculature is very like that of *Colella pedunculata*. The branchial sphincter is fairly well developed. The atrial siphon is large and projecting (Pl. XVI. fig. 5, *at.*).

The branchial sac is rather irregular in shape. Its ventral border is always much contorted on account of the remarkably irregular course of the endostyle (Pl. XVI. fig. 5, *en.*). Its anterior and posterior ends are wide, and usually almost straight and parallel to one another. The stigmata are very long, as in *Colella pedunculata*. The stigmatic cells are prominent and richly ciliated. The tentacles are very large, and are so closely placed that their bases touch (Pl. XVI. fig. 7, *tn.*). The shorter ones are scarcely half the length of the larger ones.

The alimentary canal is of fair size; it is slightly variable in its shape and course. The œsophagus is always long and narrow (Pl. XVI. fig. 5). It commences at the dorsal end of the posterior edge of the branchial sac, and runs directly or almost directly backwards (posteriorly) to open into the small more or less globular stomach (Pl. XVI. figs. 5, 6, *st.*). The stomach usually lies about half way between the posterior end of the branchial sac and the posterior end of the Ascidiozooid. It has no markings externally, and is quite opaque. The intestine commences as a narrow tube like the œsophagus, and after a very short course backwards usually opens suddenly into a considerably wider region with thick walls (Pl. XVI. fig. 6, *i.*). This narrows slightly as it runs backwards to form the most posteriorly placed part of the intestine, which turns dorsally and then anteriorly to become the rectum. The rectum is long and very wide (Pl. XVI. figs. 5, 6). It runs anteriorly past the stomach and œsophagus and along the dorsal edge of the branchial sac, to terminate at the base of the large atrial siphon. It is usually filled with fæcal matter in the form of spherical dark coloured balls (Pl. XVI. fig. 5), which are moderately firm and strong. Figure 6 shows the alimentary canal of a younger Ascidiozooid than the one represented in figure 5.

The reproductive organs are placed alongside the loop of the intestine, and a few ova and spermatic vesicles may frequently be seen (as in Pl. XVI. fig. 5), projecting beyond the rectum dorsally, opposite to the stomach.

Colella quoyi, n. sp. (Pl. XIV. figs. 1–6).

The Colony consists of a more or less rounded mass attached by a short peduncle. The upper part or head is usually rounded at the top and broader at the lower end. It may be flattened somewhat in one direction. The surface is even and very smooth. No common cloacal apertures are visible. The colour is light grey. The lower part of the head is sometimes darker than the stalk and the upper part.

The length of the head is 1·3 cm., the breadth 1·5 cm., and the thickness 0·9 cm. The length of the peduncle is about 0·8 cm., and its average thickness 0·5 cm.

The Ascidiozooids are elongated antero-posteriorly, and are placed at right angles to the outer surface. They are about 2 mm. in length and 1 mm. in breadth. The anterior end is moderately broad, and bears the branchial aperture. The posterior is rounded, and is formed mainly by the reproductive organs.

The Test is moderately firm and solid. The outer layer is smooth and is specially firm. It is of a light grey colour, but very transparent. In sections the homogeneous matrix shows very many small cells of various shapes scattered through it. Very few large bladder cells and no pigment cells are present.

The Mantle is thin. It is fairly muscular over the branchial sac, but membranous on the viscera. The muscle bands are rather irregular in their course.

The Branchial Sac is wide and rather thin. The transverse vessels are narrow and all of much the same size. There are four rows of stigmata, containing from twelve to twenty each. The stigmata are long and narrow with pointed ends.

The Endostyle is conspicuous. It is bent considerably at its anterior and posterior ends.

The Dorsal Lamina is in the form of a series of triangular languets. They are not long.

The Tentacles are placed close together. There are about twelve, all of the same length.

The Alimentary Canal is comparatively small and simple.

The Reproductive Organs are very large, and form the greater part of the visceral mass.

Locality.—Cascade Bay, Kerguelen Island; depth, 25 fathoms.

Three specimens of this species were obtained in Cascade Bay, Kerguelen Island, at a depth of 25 fathoms. Two of them (see Pl. XIV. fig. 1) are very much alike, and correspond to the description given above. The third specimen is a little different (Pl. XIV. fig. 2). The head is more regular in shape, and narrows more at the lower end than in the other two specimens. The Ascidiozooids are arranged more or less regularly in vertical lines. Each line is formed of two rows in which the Ascidiozooids alternate, so as to form a series of zigzag lines extending up from the base. The

upper one-fourth or so of the head is free from Ascidiozooids, being formed of test alone, and having a slightly decayed appearance. The peduncle of this specimen is regular in shape, and differs considerably from those of the other two specimens. It is narrow at the top where it joins the head. It then swells rapidly to (7 mm.) about twice its original thickness, and then tapers downwards, somewhat like a carrot, to a narrow base by which it is attached. This peduncle has a very slight yellowish tinge, and is marked by delicate transverse wrinkles.

In the other two specimens (Pl. XIV. fig. 1) the head is more compressed (*i.e.*, the thickness is not so great as the breadth), and the Ascidiozooids seem quite irregularly scattered over the surface. They are in all cases more numerous near the base of the head than further up. The peduncle is equally thick all the way down, and has no yellow tinge.

The Ascidiozooids are clearly visible in all the specimens; they show as opaque whitish-grey areas about 1 mm. in diameter. In a transverse section across the middle of the colony the Ascidiozooids are seen to occupy a zone a little over 2 mm. in breadth, surrounding a central mass of test about 3 or 4 mm. in breadth.

The branchial region of the body is nearly of the same size as the visceral (see Pl. XIV. fig. 5), and they are connected by a narrow neck formed of the œsophagus (*œ*), the rectum (*i.*), and the vas deferens (*v.d.*) covered by a layer of mantle. The branchial aperture (*br.*) is placed nearly in the centre of the wide anterior end, while the atrial siphon (*at.*) projects from the dorsal side. There are apparently no vascular appendages.

The test is firmer even in the centre of the colony than is usual in allied species. It is very transparent, which is no doubt partly due to the absence of vascular appendages from the Ascidiozooids. The test cells are very abundant, and they are of fairly large size. Bladder cells are rare, and seem to be mainly if not solely in the superficial layer of the test.

The mantle musculature is like that of *Colella pedunculata*. The sphincters are fairly strong, and there is a well-developed branchial siphon (Pl. XIV. fig. 5, *br.*). Longitudinal muscle bands radiate from the base of both apertures, and form an irregular network over the sides of the branchial part of the body (see Pl. XIV. figs. 5, 4).

The branchial sac is nearly as wide as it is long (Pl. XIV. fig. 5). The stigmata are large, a circumstance which gives the sac a delicate appearance. The narrow pointed ends of the stigmata (Pl. XIV. fig. 3) form a constant characteristic. The ventral border of the branchial sac is very convex, and this causes the endostyle to bend almost in a C-shaped curve (Pl. XIV. fig. 5, *en.*). The course of the endostyle is slightly undulating. The languets are shorter and stouter than usual. The tentacles are not large, and they are peculiarly closely placed, the line of their insertion forming a very small circle. The prebranchial zone is large, and is particularly wide at the ventral edge, where the anterior extremity of the endostyle is very distant from the base of the ventral tentacles.

The alimentary canal is comparatively inconspicuous, and is usually more or less hidden by the reproductive organs (Pl. XIV. fig. 5). The œsophagus (*œ.*) commences rather at the dorsal side of the posterior end of the branchial sac, and leads directly backward in a funnel-like form (Pl. XIV. fig. 6, *œ.*) to the anterior end of the stomach. The stomach is not large, and seems to vary a little in its exact shape. In some cases (Pl. XIV. fig. 5, *st.*) it is elliptical with narrow ends, which pass gradually the one into the œsophagus and the other into the intestine, but in one Ascidiozooid examined the stomach was truncated at the anterior end and the funnel-shaped œsophagus entered it in a slight depression (see Pl. XIV. fig. 6, *st.*). The stomach was long and nearly equally wide throughout its anterior three-fourths, which was directed dorsally and posteriorly. The remaining fourth narrowed rapidly, and turned abruptly so as to form a right angle with the front part and point ventrally and posteriorly. The posterior end was only about half as wide as the anterior, and narrower than the intestine (Pl. XIV. fig. 6, *i*). The intestine is in all cases a rather narrow tube, which runs posteriorly and then ventrally, and turns anteriorly with a wide curve leaving an open loop (Pl. XIV. fig. 5). It crosses close to the anterior end of the œsophagus, and then becomes the rectum, which is continued up the dorsal edge of the branchial sac towards the atrial aperture.

The genital glands are very large, but in all the Ascidiozooids examined consist of the male system only. There are a number of large ovate and pyriform seminal vesicles, forming together a mass about four times as large as the stomach (Pl. XIV. fig. 5, *g.*). They fill up the greater part of the intestinal loop, and project beyond the intestine posteriorly and ventrally for a considerable distance. Thus the posterior half or so of the visceral mass is usually formed by the reproductive organs. Each seminal vesicle has a short narrow duct, and the various ducts join to form a very large vas deferens, which leaves the mass at its posterior end (Pl. XIV. fig. 5, *v.d.*), and, curving round ventrally and then anteriorly, forms the ventral border of the greater part of the visceral mass. Eventually the vas deferens reaches the rectum, along with which it crosses the base of the branchial sac to reach its dorsal edge. In the whole of its course the vas deferens is a most conspicuous object. It is usually nearly as wide as the intestine (see Pl. XIV. fig. 5), and takes up stain very readily.

Colella murrayi, n. sp. (Pl. XVII. figs. 1–11).

The Colony is rudely club-shaped, consisting of a large expanded head supported by a short stout peduncle. The head is longer than it is broad, and is flattened laterally. The upper end is wide, and has an unevenly truncated appearance. The highest point is in the middle. The lower end tapers into the peduncle. The sides of the head are nearly straight. The peduncle is shorter than the head, and is not flattened laterally. It is not wide relatively to the head, but is strong. The surface is even, and fairly smooth.

The colour is a light grey, with a yellowish tinge over the head. There is a certain amount of opaque white pigment in the test.

The length of the head is 2·5 cm., the greatest breadth 1·8 cm., and the average thickness 0·8 cm. The length of the peduncle is 1·5 cm. and its thickness 0·6 cm.

The Ascidiozooids are comparatively small. They are elongated antero-posteriorly, and measure about 1·5 mm. in length and 0·5 mm. in greatest breadth. The branchial and visceral parts of the body are distinct, and a narrow vascular appendage is prolonged from the posterior end of the body through the common test.

The Test is firm and moderately tough. In the peduncle it is especially tough. With the exception of the superficial layer of the head it is rather opaque, and this layer becomes opaque only where the white pigment is deposited.

Bladder cells are present in large numbers, especially in the superficial layers. Consequently the structureless matrix is greatly reduced. It contains the usual small cells of various shapes; most of these are rounded or fusiform, and in some parts, especially of the peduncle, they are extremely abundant. In the central part of the head and peduncle the test is very spongy in its coarser structure, and is penetrated by the numerous vascular appendages.

The Mantle is thin and membranous. The musculature is very weak, consisting merely of very delicate bundles of muscle fibres, most of which run transversely. The branchial sphincter is moderately strong.

The Branchial Sac is large. The transverse vessels are of a fair size and all alike. The stigmata are long and narrow, with rounded ends. They are arranged with regularity. The stigmatic cells are short, and pointed at their free ends. They are richly ciliated.

The Dorsal Lamina is formed of a series of short pointed languets.

Locality.—Station 163D, June 12, 1874; lat. 33° 57′ 30″ S., long. 151° 39′ 15″ E.; depth, 120 fathoms; bottom, green sand.

Two specimens of this interesting species were obtained off the south-east coast of Australia from a depth of 120 fathoms. They differ slightly from one another in appearance, but must certainly be placed under the same species.

The head, which is large compared with the peduncle (Pl. XVII. fig. 1), is flattened laterally, and becomes thinner as it recedes from the peduncle, so that in lateral view it is somewhat wedge-shaped. In a front view (Pl. XVII. fig. 1), on the other hand, it narrows as it approaches the peduncle, and the broadest point is close to the uneven upper end. At the base the head passes quite gradually into the top of the peduncle, and there is no line of demarcation between the two. The upper end of the head looks at first sight as if it was partially decayed and torn, but a careful examination does not afford any evidence of this being the case. Although there are no Ascidiozooids in the terminal 2 to 3 mm. (Pl. XVII. fig. 2), still the test seems whole and healthy

looking. The head varies in its thickness from 1 cm. a short distance above the peduncle to 0·5 cm. at the upper end. One surface of the head is much more convex than the other, but this is probably an individual variation.

The peduncle is strong, and is almost circular in section. It is narrowest a little below the base of the head, and then expands slightly towards its lower end (Pl. XVII. fig. 1). The actual point of attachment is not present in the specimen figured, but must have been immediately below the torn end. The peduncle is entire in the other specimen, and is somewhat irregular in form at the point of attachment.

The general colour of the colony is a light grey, but the head has a slight but warm yellowish tinge, except at the very base, at the upper end, and along a series of lines which run vertically between the rows of Ascidiozooids. At these points the colour is still grey, or even in places white, and is seen on a close examination to be due to a large number of small rounded masses of opaque white pigment imbedded in the test. This pigment is most abundant at certain points between the rows of Ascidiozooids, and at the top of the colony (Pl. XVII. fig. 2), and is present in much greater quantity in one of the specimens than in the other, thus making a considerable difference in the external appearance of the two colonies. The surface is not perfectly smooth, but appears to be very finely roughened (Pl. XVII. fig. 8).

The Ascidiozooids are clearly visible on the surface of the colony (Pl. XVII. fig. 1). They show as opaque yellowish-grey areas about 1 mm. in diameter. They are smallest at the base of the head, and increase in size as they are traced upwards. They are arranged with great regularity in vertical lines, and these rows are placed in pairs, each pair being separated from its neighbours by ridges of test from 1 mm. to 1·5 mm. in width. It is in these areas that the vertical bands of white pigment are developed (Pl. XVII. figs. 2, 8). In each pair of rows the Ascidiozooids are placed alternately so as to form a zigzag line (Pl. XVII. figs. 1, 2). The longest row of Ascidiozooids is 2·2 cm. from base to top. The bodies of the Ascidiozooids extend inwards nearly at right angles to the surface, but only occupy a zone about 1·5 mm. in width. The remainder of the head is formed by a spongy mass of test, penetrated in all directions by the vascular appendages of the Ascidiozooids. In a vertical section the lower part of the head and the peduncle are seen to be marked by delicate longitudinally running fibres. This appearance is due to the vascular appendages. The thoracic region of the Ascidiozooid is larger than the abdominal (Pl. XVII. fig. 9). It is nearly as broad as it is long, while the alimentary and reproductive viscera form a rather narrow mass elongated antero-posteriorly.

As a whole the test is firmer than usual in this species. The outer layer of the head forms a strong but thin transparent membrane, in certain parts of which aggregations of white pigment are formed between the anterior ends of the Ascidiozooids (Pl. XVII. fig. 4, *p.c.*). The test of the inside of the head is more tough and spongy in its nature, and is rather opaque. The peduncle, although very much vacuolated, is firm

and tough, and quite opaque except in thin sections or at the edges, where it has a slightly hyaline appearance. In its histology the test differs considerably in different regions. The outer layer in the head contains great numbers of bladder cells, and the matrix is consequently reduced to a reticulum (Pl. XVII. fig. 8). Between the bladder cells numbers of the usual small rounded and fusiform cells are present, and here and there large pigment corpuscles are met with. These are like bladder cells in shape, and are usually larger, but they are filled with granular masses of opaque white pigment (Pl. XVII. fig. 8, *p.c.*).

The peduncle is traversed by longitudinally running canals which contain the vascular appendages. These canals are nearly circular in cross section (Pl. XVII. fig. 5), and give the tissue its coarsely spongy texture. The test between these canals is in its outer parts (Pl. XVII. fig. 6) filled with bladder cells and great numbers of small cells, many of which are most beautifully branched, their processes extending through the structureless matrix to great distances. In the centre of the peduncle the tissue is much more dense. Bladder cells are absent, while the smaller cells are very peculiar; they are nearly all larger than elsewhere, and of a circular or rudely square or oblong shape (Pl. XVII. fig. 7, *p.c.*). They stain with picrocarmine a homogeneous red tint, and show no nuclei.

The mantle is singularly weak (Pl. XVII. fig. 9). In some cases the muscle bundles contain only a single delicate muscle fibre each. On these the nuclei are seen as distinct fusiform swellings. The atrial siphon is large, but has no distinct sphincter (Pl. XVII. fig. 9, *at.*).

The transverse vessels of the branchial sac (Pl. XVII. fig. 3, *tr.*) are rather wide, and have delicate horizontal membranes. The stigmata are very like those of *Colella gaimardi* (Pl. XIV. fig. 8.).

The alimentary canal is narrow (Pl. XVII. fig. 9). The œsophagus is long but narrow; it runs nearly directly backwards, and opens into the anterior end of the somewhat ovate stomach (Pl. XVII. fig. 9, *st.*). The stomach is not large, and its walls are smooth. It tapers posteriorly towards the intestine, which runs backwards and turns round ventrally and then anteriorly forming a narrow loop. It crosses the œsophagus to become the rectum, running up the dorsal edge of the branchial sac.

The reproductive organs form a large ovate mass placed in the intestinal loop, and extending beyond the intestine ventrally and posteriorly (Pl. XVII. figs. 9, 10, *g.* and *t.v.*). It was formed entirely in all the Ascidiozooids examined by opaque ovate spermatic vesicles. Each of these has a short narrow duct (Pl. XVII. fig. 11), and these join together at the posterior end of the body to give rise to the vas deferens (Pl. XVII. figs. 9, 11, *v.d.*). This tube is conspicuous throughout its whole course. It curves round ventrally and then anteriorly from its point of origin, and ascends along the ventral edge of the visceral mass until it reaches the rectum. At its upper end for a short distance it becomes swollen to about twice its ordinary calibre.

The relation of the genital organs to the alimentary canal is seen in a transverse section of the abdomen (Pl. XVII. fig. 10). This section must have been cut obliquely with the dorsal edge more anterior than the ventral, as the spermatic vesicles do not usually extend so far forward as the stomach. Probably a line connecting *g.* and *st.* in figure 9 would be nearly in the plane of the section. The vas deferens in the transverse section (Pl. XVII. fig. 10, *v.d.*) lies further from the intestine than it generally seems to be in surface views and dissections. The space between the stomach and intestine is occupied by the heart, in the walls of which cross striped fusiform muscle fibres are distinctly visible.

Colella murrayi, var. *rubida*, nov. (Pl. XVII. figs. 12–14).

The collection contains a small colony which was dredged from Station 162,[1] in Bass Strait, at a depth of 38 fathoms, and which I was at first inclined to regard as belonging to *Colella murrayi*. A closer examination, however, revealed several points of difference, so that I have thought it best to place this specimen as a variety of that species. It is unnecessary to give here a formal description; that belonging to the last species will serve, if the various differences to be enumerated presently are borne in mind.

The colony (Pl. XVII. fig. 12) consists of a short, somewhat triangular head, borne on the summit of a short thick peduncle. The head is flattened laterally, and has a truncated appearance at the top, which is the widest point. The sides slope downwards, the head tapering gradually into the peduncle. The extreme length of the head is 7 mm., the greatest breadth almost 10 mm., while the thickness varies from 5 mm. at the base of the head, where it joins the peduncle, to 3 mm. at the top. The peduncle is between 6 and 7 mm. in length and about 5 mm. in thickness. It expands considerably at the base where attached. It is not flattened laterally.

From the above description it is clear that this colony (Pl. XVII. fig. 12) agrees very closely in general form with the specimens described under the last species. The colour, however, is very different. In the present case the whole colony is of a somewhat ruddy brown colour. There is no distinction between the tint of the peduncle and that of the head, but the extreme top of the colony (Pl. XVII. fig. 12) is slightly lighter and more transparent than the rest. There is no white pigmentation in any part of the specimen. The surface is even, but distinctly rougher than in the last species, being finely granulated all over both head and peduncle.

The Ascidiozooids are comparatively few in number, and seem smaller than in the last species. They are arranged in the same manner, but the vertical rows are not quite so distinctly marked off into pairs (Pl. XVII. fig. 12). There are about one hundred and twenty Ascidiozooids altogether in the colony, and they form twelve pairs of vertical

[1] Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ E.; depth, 38 fathoms; bottom, sand and shells.

rows. The ends of the Ascidiozooids at the surface are very small, and show merely as small dark brown points. No common cloacal apertures are visible in any part of the colony. The Ascidiozooids are largest at the top and smallest near the base of the head. Their vascular appendages can be faintly seen in a very good light as dark streaks running down the peduncle.

Sections show at once that the brown colour of the colony is due to a very large number of small clear yellowish-brown pigment corpuscles of a rounded shape which are scattered through nearly all the tissues of the body. In the test, which is otherwise very much the same as in *Colella murrayi*, they are present in the outer layers scattered through the matrix between the bladder cells. They are present in large quantities in some parts of the mantle, especially along the dorsal line and round the base of the branchial siphon. The musculature of the mantle is remarkably feeble, and, where pigment cells are absent, this membrane is perfectly transparent. The branchial aperture is distinctly six-lobed, and the siphon is fairly strong.

In the branchial sac the transverse vessels do not seem quite so wide as in *Colella murrayi*. The stigmata are regular. They are long, with rounded ends, and are usually considerably wider than the fine longitudinal vessels between them (Pl. XVII. fig. 14, *l.v*). The ciliated cells are distinct.

The endostyle is conspicuous. It is long and straight. The tentacles are short and stout. There are eight, four longer and four shorter placed alternately (Pl. XVII. fig. 13, *tn.*, *tn'.*).

Altogether the main difference between the colony under consideration and those belonging to *Colella murrayi* is in the pigmentation. The latter are entirely free from yellowish-brown pigment corpuscles, and are very remarkably coloured in places by opaque white granules, while in the former no white pigmentation is present, and the entire colony is coloured by small round clear yellowish-brown pigment corpuscles. This produces such an entirely different aspect, not only in the colony as a whole, but also in the various organs separately, that I think the specimen is worthy of being regarded as a marked variety, but certainly not as a distinct species.

Colella ramulosa, n. sp. (Pl. XV. figs. 14–17).

The Colony is composed of one or more rounded masses borne on long branched peduncles. The rounded mass or head is usually irregularly flattened in one direction. The peduncle is very irregular in its course and in its thickness. The colour of the head varies from light to very dark grey. The peduncle is always of a straw yellow colour. The surface is uneven but smooth. No common cloacal apertures are visible.

The length of the head is 12 mm., the breadth 9 mm., and the thickness 4 mm. The length of the peduncle is about 5 cm., and the thickness 2 mm.

The Ascidiozooids are much elongated antero-posteriorly, and are large. They are usually fully 3 mm. in length, and a little over 1 mm. in greatest breadth. They are not arranged with regularity. The posterior end is prolonged into a narrow vascular appendage.

The Test is very soft and flexible. The outer layer of the head is smooth but not firm. It is very transparent. There are few cells in the homogeneous matrix.

The Mantle is thin and delicate. The muscle bands are fairly strong but distant. The branchial sphincter is large.

The Branchial Sac is of considerable length. There are at least four rows of long stigmata. The transverse vessels are wide. The stigmata are large and are arranged with great regularity.

The Dorsal Lamina is formed of short languets.

The Tentacles are very long. There are about twelve, and they seem all of much the same size.

The Alimentary Canal is large, and forms the greater part of the visceral mass.

Locality.—Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature 46° F.

Most of the specimens of this species were obtained from a bottle labelled "Compound Ascidians and Gorgonoids from various dredgings, hardened in absolute alcohol." As, however, one small colony was found, along with some specimens of Didemnidæ, in a bottle from Station 311, on the west coast of Patagonia, it is probable that all the specimens of the species were obtained from that locality.

There are eleven or twelve more or less perfect heads and a large number of peduncles, many of them mere fragments. The dimensions given above are those of the largest head; two or three of the smaller ones are only 3 or 4 mm. in greatest length. Most of the specimens are more or less torn or injured. The largest colony has three heads remaining, and the peduncle branches six times. The colony figured (Pl. XV. fig. 14) is smaller, but more complete. Usually the peduncle simply bifurcates at each division, but in one or two cases (Pl. XV. fig. 15) three branches spring from the same point. Some of the fragments of peduncle are very long, and give off many branches. They are frequently incrusted with foreign objects, and in all probability lay on the sea-bottom. They are much too weak to support the weight of the head in an upright position even in water, and their irregular winding courses suggest that they have been recumbent.

The general shape and appearance of the head is very like that of *Colella pedunculata*, but the branched peduncle is quite peculiar. The colour of the head varies much. In the smaller specimens it is a light grey, while in larger ones it is darker, and in the largest it is a very dark grey indeed. The peduncle does not vary so much in

colour. It is always more or less of a straw yellow, in some cases a little brighter than in others.

The Ascidiozooids are always clearly visible on the surface. They are closely placed but have no regular arrangement (see Pl. XV. fig. 14). At the upper end of the head they seem to be rarer than elsewhere, or absent. This part of the colony sometimes has a decayed appearance. The shape of the Ascidiozooids is long and narrow (Pl. XV. fig. 17).

The branchial sac occupies about one-half of the total length, and is considerably narrower than the widest part of the body, which is towards the posterior end of the visceral mass (Pl. XV. fig. 17). The vascular appendage (*v.ap.*) is narrow, and springs from the middle of the posterior end.

The test contains a fair number of small cells scattered through the homogeneous matrix. Bladder cells are present in some places, but they are not very numerous. Some parts of the test contain very few cells indeed. The mantle is not strong. In some places it contains patches of large opaque white pigment cells. These are especially developed along the course of the endostyle towards its anterior extremity, and frequently form a pigmented mass which may be seen by the naked eye in a surface view of the colony, showing through the transparent test as a small white speck. The endostyle is large and conspicuous; its course is undulating.

The branchial sac is peculiarly long and narrow (Pl. XV. fig. 17). The transverse vessels are wider than is usual in the genus (Pl. XV. fig. 16, *tr.*), and have narrow horizontal membranes. The stigmata are large, but numerous; they have rounded ends, and are bounded by very distinct ciliated cells pointed at their free ends. The tentacles are long and thin, and their bases are closely placed.

The abdomen is as long as and broader than the thoracic part of the body, and is almost entirely formed by the alimentary canal. The œsophagus commences at the narrow posterior end of the branchial sac and runs backwards to open into the large globular stomach which forms a rounded projection upon the dorsal edge of the abdomen (Pl. XV. fig. 17, *st.*). The stomach is perfectly plain; it has no ridges or folds. The intestine springs from the posterior end of the stomach and runs first posteriorly, then curves round ventrally and turning anteriorly runs forwards, and eventually crosses the œsophagus to become the rectum, which may be traced nearly half way up the dorsal edge of the branchial sac (Pl. XV. fig. 17, *r.*).

The reproductive organs form a rounded mass placed in the intestinal loop, and projecting beyond the intestine ventrally and to a slight extent posteriorly (Pl. XV. fig. 17, *t.v.*). They consist in all the Ascidiozooids examined merely of spermatic vesicles, no ova being present. These Ascidiozooids were all large and mature, no young ones being found in the colony examined. The vas deferens (Pl. XV. fig. 17, *v.d.*) leaves the genital gland at its posterior end and curls round ventrally and then anteriorly to reach

the intestine, which it crosses about the level of the œsophagus, so as to come to lie on the dorsal edge of the rectum, along which it runs to its termination.

No incubatory pouches or larvæ were found in the colony.

Colella concreta, n. sp. (Pl. XVI. figs. 8–16).

The Colony takes the form of a number of irregularly club-shaped masses united together by their lower ends, where they are attached to some foreign object. Each club-shaped mass consists of an upper more or less rounded head, the part occupied by the bodies of the Ascidiozooids, and a thick irregular stalk tapering downwards to the point of attachment.

The general colour is yellowish-grey. The test of the head is light grey, while the Ascidiozooids show through as opaque light yellow bodies. The surface of the head is even and smooth; that of the stalk is slightly uneven in places and not very smooth. No common cloacal apertures are visible.

The average length of one of the club-shaped masses is about 3 cm. The length of the head is usually about 8 mm., its breadth 13 mm., and its thickness 11 mm. The usual length of the stalk is 2 cm., its breadth at the top 6 mm., at the base 2 mm.

The Ascidiozooids are elongated antero-posteriorly, and are placed mostly at right angles to the upper surface of the colony. They are about 3 mm. in length and 1 mm. in greatest breadth. The anterior end is moderately wide. It bears both apertures. The thoracic region is usually not quite so large as the abdomen. The posterior end is narrow, and is continued into a slender vascular appendage which extends downwards through the test, usually for about 3 mm., and then terminates in a bulb.

The Test is very soft and delicate. The outer layer on the upper surface of the head is smooth and glistening, and is firmer than the deeper parts. The stalk is stronger than the test of the head, and is more opaque.

The matrix is homogeneous, and contains great numbers of rather large fusiform and stellate cells. No bladder cells or pigment cells are present.

The Mantle is fairly strong on the branchial part of the body; over the viscera it is thin and membranous. The chief muscle bands run transversely and are regularly placed.

The Branchial Sac is small and thick walled. It contains about eight rows of stigmata on each side. The alternate transverse vessels are larger than those between them. The stigmata are rather narrow and are closely placed.

The Endostyle is very conspicuous. Its course undulates greatly from side to side, especially towards its posterior end.

The Dorsal Lamina is formed of a series of large pointed triangular languets.

The Tentacles are not large, but they are fairly numerous. There are about sixteen, all of the same size.

The Dorsal Tubercle is a small circular opening at the base of the most anterior languet.

The Alimentary Canal is large and conspicuous.

The Reproductive Organs lie alongside the intestine. The adult Ascidiozooids are hermaphrodite.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

One very large colony and several smaller specimens of this species were collected at Kerguelen Island from depths of 10 to 60 fathoms.

The larger colony (see Pl. XVI. fig. 8) consists of about thirty irregularly club-shaped masses all joined together by their lower ends. Each of these may be called a system.[1] The smaller systems are each merely a small knob, the upper rounded free end of which contains a few young Ascidiozooids, while the lower part, consisting of a mass of test penetrated by the vascular appendages, forms a short stalk. In the larger systems the shape is much more irregular. The head expands laterally so as to become more flattened on the upper surface, which, however, is always a little convex (Pl. XVI. fig. 8). This upper surface is more or less circular in outline, and has a well-defined edge from which it rapidly narrows downwards to the top of the stalk. The length of the head (from the top of the stalk to the highest point of the convex upper surface) is usually considerably less than the average diameter of its upper surface. In a head the length of which is 8 mm., the average diameter is about 12 mm.

The stalk, even in the largest systems, remains narrow at its lower fixed end, but thickens greatly and in some cases very irregularly as it is traced upwards to the head (Pl. XVI. fig. 8). There is a great deal of variability both in length and thickness of stalk, but on an average the top is about three or four times as thick as the base.

The general shape and appearance of the small systems is very like that of many specimens of *Amaroucium proliferum*, while the larger systems approach more the forms seen in the genus *Distaplia*.

The colour of the colony approaches yellow rather than grey. The stalk is yellowish-grey and nearly quite opaque. Here and there a more yellow and more opaque line may be seen running longitudinally for a short distance. This is caused by a vascular appendage lying close to the surface.

The test of the head is distinctly greyer and more transparent, allowing the yellow opaque bodies of the Ascidiozooids to show through with considerable clearness. In one or two systems openings resembling common cloacal apertures were found about the middle of the upper surface of the head, but in most cases, on account of the extreme delicacy of the superficial layer of test, it is impossible to make them out.

[1] The relation of these masses to the regular systems, of *Botryllus* for example, is difficult to determine from spirit specimens; possibly some of them have more than one common cloacal aperture, and are therefore equivalent to several true systems.

The Ascidiozooids are apparently arranged quite irregularly. There are about fifty in a head of average size. Their anterior ends form light yellow areas rather less than 1 mm. in diameter on the upper surface of the head. The Ascidiozooid is large, and has a curious shape (Pl. XVI. fig. 9). The branchial aperture is quite at the ventral edge of the anterior end, and is clearly six-lobed. The atrial siphon is larger than the branchial (Pl. XVI. fig. 11, *at.*), is not quite at the dorsal edge, and is not lobed. The endostyle is long and nearly straight, and forms a conspicuous border to the ventral edge of the branchial sac. This ventral edge is the longest part of the sac; the dorsal edge is considerably shorter. The visceral part of the body (abdomen) is in most cases rather larger than the branchial region, and is narrowed anteriorly and posteriorly (Pl. XVI. figs. 9, 11). The vascular appendage (Pl. XVI. fig. 9, *v.ap.*) is usually at least as long as the rest of the Ascidiozooid. It is conspicuous and of moderate width, and runs almost directly backwards towards the stalk. It ends in an ovate bulb, which occupied about one-fourth of the length of the appendage.

The cells of the test are extremely numerous. Most of them are fusiform, with very long fibres projecting from their narrow ends. The nuclei are large and take up stain readily. Small bladder cells are present in some parts of the test.

The mantle is strong on the branchial part of the body. There are a small number of strong muscle bands which run transversely. They are regularly arranged and usually equidistant (Pl. XVI. fig. 12). The sphincters are strong, especially that around the branchial siphon. Over the viscera the mantle is thin and almost destitute of musculature. Here and there, especially over the stomach, patches of opaque white pigment cells occur, and smaller groups may be sometimes seen upon the branchial siphon. The vascular appendage has a few longitudinally running muscle bands (Pl. XVI. fig. 10), which are continued down from the mantle.

The branchial sac is very narrow (Pl. XVI. fig. 11). Its posterior end is pointed, and lies at the ventral edge of the body. The larger alternate transverse vessels have a few muscle fibres. The stigmata are long and narrow, and are very regularly arranged (Pl. XVI. fig. 13, *sg.*).

The tentacles are long and thin, but not very large. They are all of much the same size (Pl. XVI. fig. 14, *tn.*). The dorsal languets are very large. They are of a long triangular form, and are flattened antero-posteriorly; their edges are ciliated (Pl. XVI. fig. 14, *l.*). Their bases are connected by a strong band of muscle fibres (Pl. XVI. fig. 14, *d. l.*), which occupies the median dorsal line of the branchial sac.

The alimentary canal is, relatively to the size of the branchial sac, very large (Pl. XVI. fig. 11). The œsophagus begins at the dorsal edge of the posterior end of the sac, and runs straight backwards; it is very short. The stomach is large and ovate in shape, with the long axis directed antero-posteriorly. The stomach forms the greater part of the ventral edge of the visceral mass (Pl. XVI. fig. 11, *st.*). It is smooth externally,

and is opaque. When split open or sectionised it is seen to have a very large number (varying from twenty-five to forty in the various stomachs examined) of folds in its interior (see Pl. XVI. fig. 15). These folds are not very prominent, but are closely placed; they run longitudinally, but are not continued over the entire length of the organ. They frequently branch, and new folds commence at various points, thus producing undulations in the course of the neighbouring ones. Figure 15 represents not a surface view of the folds, but an optical section, obtained by focussing down a little from the inner surface. In this way the columnar cells which form the folds are seen in profile; *gr.* indicates the groove between two folds, and *fil.* the centre of a fold.

The stomach opens on the dorsal side of its posterior end into a very short piece of narrow intestine, which at once dilates into a large globular cavity, forming the posterior and dorsal part of the visceral mass (Pl. XVI. fig. 11). This is continued at its anterior extremity into a small funnel-shaped piece of intestine, which, after a slight constriction, opens into the long rectum. This part of the tube is narrow at its commencement, and runs anteriorly and slightly ventrally to reach the œsophagus. It then runs straight forwards, swelling slightly as it goes, and finally terminates in the anus, which is placed at the base of the atrial siphon (Pl. XVI. fig. 11, *at.*). The anterior part of the rectum is very large, and is usually distended with dark-coloured fæcal matter. Viewed as a whole, the alimentary canal is remarkable for its large size and for the irregularity in its calibre. The intestine lies throughout its entire course on the dorsal side of the stomach.

All the Ascidiozooids examined were hermaphrodite, there being one or two large ova along with the spermatic vesicles (Pl. XVI. figs. 9, 11). The latter (Pl. XVI. fig. 11, *t.v.*) stain more deeply with picrocarmine than the ova, and are large, opaque ovate bodies, placed in groups on the side of the intestine, and projecting beyond it on the dorsal edge and posteriorly. Each Ascidiozooid has a large bunch of from six to twelve vesicles (Pl. XVI. fig. 16, *t.v.*). The delicate ducts from the vesicles join at the base of the long and wide vas deferens, which is a conspicuous object running alongside the rectum throughout its entire length.

Distaplia, Della Valle.

Distaplia, Della Valle, Nuove Contribuzioni alla storia naturale delle Ascidie Composte, &c., Reale Accademia dei Lincei, 1880–81, p. 18.
Distaplia, von Drasche, Die Synascidien der Bucht von Rovigno, Wien, 1883, p. 22.

Colony in the form of lobed masses or club-shaped knobs.
Systems distinct, each one forming a knob or lobe of the colony.
Ascidiozooids elongated antero-posteriorly, and placed vertically in the colony. Branchial aperture six-lobed. Atrial aperture provided with a languet.
Test gelatinous, penetrated by ectodermal prolongations from the Ascidiozooids.

Branchial Sac with four rows of long stigmata.
Dorsal Lamina represented by short languets.
Alimentary Canal posterior to the branchial sac. Stomach ovate, smooth-walled.
Reproductive Organs placed on the right side of the intestinal loop. The ova develop in an incubatory pouch formed as a diverticulum from the atrial cavity. The larva is of large size, and is gemmiparous.

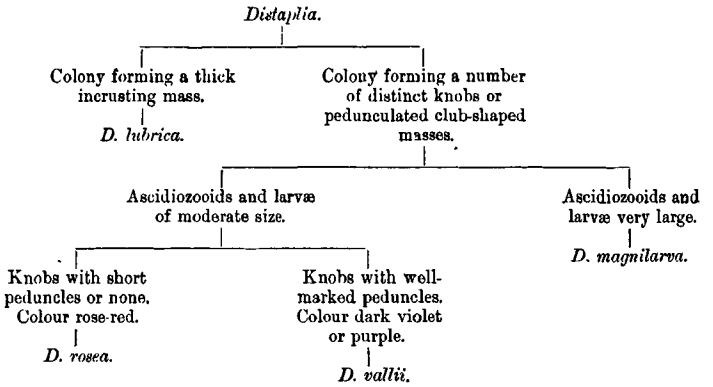
This genus was founded in 1881 by Della Valle[1] for two species of Compound Ascidians from the Mediterranean which he named *Distaplia magnilarva* and *Distaplia rosea*. He pointed out at the same time that Oscar Schmidt's *Cellulophana pileata*,[2] which F. E. Schulze had shown in 1877[3] to be not a Sponge but an Ascidian, and Kowalevsky's *Didemnium styliferum*,[4] which is certainly not one of the Didemnidæ, would probably find their proper places in the new genus.

In external appearance, as Della Valle pointed out, *Distaplia* resembles colonies of the genus *Aplidium*, but there the resemblance ends, and its true affinities are with *Cystodytes* and *Distoma*. It is therefore placed quite correctly by von Drasche in the family Distomidæ, but it is also allied with his family Chondrostachyidæ, being united to *Chondrostachys* and *Oxycorynia* by the new Challenger genus *Colella*.

A new species, *Distaplia lubrica*, from the Gulf of Rovigno, was added to the genus by von Drasche in 1883, and in the same year I found in the collection of Tunicata obtained during the "Porcupine" and "Lightning" expeditions a specimen of *Distaplia*, which in my Report[5] upon that collection I referred provisionally to *Distaplia rosea*, Della Valle. This specimen, which was dredged in Tangier Bay, Morocco, from a depth of 35 fathoms, is discussed further on. Finally, in the Challenger collection there occur several small colonies obtained from Station 212, near the Philippine Islands, which undoubtedly belong to the genus *Distaplia*, and closely resemble the specimen from Tangier Bay. They do not, however, agree well with any of the previously described species. They differ entirely from von Drasche's *Distaplia lubrica* in the form of the colony, and they differ in certain characters from each of Della Valle's species while agreeing with each of them in other features. Consequently it is necessary to consider these "Porcupine" and Challenger specimens as belonging to an independent species, which may be regarded as occupying a position between *Distaplia magnilarva* and *Distaplia rosea*. I have named it *Distaplia vallii* in honour of the founder of the genus.

The four known species of the genus may be distinguished briefly by the following characters:—

[1] Nuove Contribuzioni, &c., Roma, 1881.
[2] Spongien des Adriat. Meeres, 1862.
[3] *Zeitschr. f. wiss. Zool.*, Bd. xxix. p. 119.
[4] Ueber die Knospung der Ascidien, *Archiv f. mikrosk. Anat.*, Bd. x., 1874.
[5] *Trans. Roy. Soc. Edin.*, vol. xxxii., part ii., p. 219, 1884.


Distaplia.
Colony forming a thick incrusting mass.
D. lubrica.
Colony forming a number of distinct knobs or pedunculated club-shaped masses.
Ascidiozooids and larvæ of moderate size.
Ascidiozooids and larvæ very large.
D. magnilarva.
Knobs with short peduncles or none. Colour rose-red.
D. rosea.
Knobs with well-marked peduncles. Colour dark violet or purple.
D. vallii.

Distaplia vallii, n. sp. (Pl. XVIII. figs. 1 to 6).

The Colony consists of one or more rounded or dome-shaped masses or heads borne on the summit of well-marked peduncles. The upper surface of the head is convex, and its widest part always exceeds the peduncle in diameter. The peduncle is usually two or three times as long as the head, and is nearly as wide. At the top it passes gradually into the base of the head, and at its lower end it may be united by stolon-like processes to the other parts of the colony. The surface is even but not very smooth.

The colour of the peduncle is light grey with a rosy tinge. The head varies from red in its lower part through violet and purple to nearly black at the top.

The length of the head is 7 mm., its greatest breadth is 9 mm. The length of the peduncle is 15 mm., and its average thickness 5 mm.

The Ascidiozooids are elongated antero-posteriorly and are placed vertically in the colony. Each is about 2 mm. in length, and has the body divided into two regions (the thorax and the abdomen) of nearly equal size.

The Test is soft. It is of a grey colour, and is fairly transparent. The external layer in the head contains a good deal of dark pigment. Small test cells are numerous and of various shapes, but there are no bladder cells.

The Mantle is thin but fairly muscular. The muscle bands are fine but numerous, most of them run transversely. In some places the mantle is considerably pigmented.

The Branchial Sac is large. There are four rows of long stigmata. Each of these is crossed by a narrow transverse vessel which does not interrupt the stigmata.

The Dorsal Lamina is formed of a series of short triangular languets.

The Tentacles are not large. There are eight of much the same size and some smaller intermediate ones.

Localities.—(*a*) Tangier Bay, on the coast of Morocco; depth, 35 fathoms. One large colony with two heads, obtained during the cruise of H.M.S. "Porcupine" in 1870. (*b*) Station 212; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 to 20 fathoms; January 30, 1875; bottom sand.

The species of this genus appear to be very variable in shape and pigmentation, and it is a difficult matter to determine how far external characters are of value as diagnostic features. The above specific description is taken from the largest of the Challenger specimens obtained at the Philippine Islands, and the other smaller specimens agree with it closely. The peduncles spring from an irregular stolon-like base of a light grey colour, considerably incrusted with sand-grains and shell fragments (Pl. XVIII. fig. 1). The peduncle is always stout, and its length is about three times its average thickness. It widens somewhat as it is traced upwards from the base, and passes gradually into the head at the top. The rosy tint is most marked at the upper end of the peduncle; lower down the colour is greyish. The head is dome-shaped in the largest specimen (Pl. XVIII. fig. 1), and more rounded at the top in the others. There is a common cloacal aperture near the centre of the upper end, and from this lines of Ascidiozooids radiate outwards and downwards to the equatorial region. Consequently each head contains one system only. There are no Ascidiozooids below the equatorial region, the widest part of the head. The Ascidiozooids form about twenty rows, and there are about five in each row; the branchial apertures are very distinct. The surface of the head is smooth. Its colour is rose-red below the equatorial part, passing into dark shades of purple and violet above, and finally becoming almost black at the top around the common cloacal aperture. The margins of that aperture and also of the branchial openings of the Ascidiozooids are marked with a line of opaque white pigment.

The "Porcupine" specimen from Tangier Bay (see Pl. XVIII. fig. 2) is larger than any of the Challenger specimens, and consists of two heads supported by stout branches of a single peduncle. The larger head is 11 mm. in length and 15 mm. in greatest breadth. The branch of the peduncle which bears it is 12 mm. in length and 10 mm. in greatest breadth, while the common basal part of the peduncle is about 20 mm. in length and 6 mm. in average breadth. The general character of this colony agrees fairly with that of the Challenger specimens, the only peculiarity being that the peduncle is here branched. Possibly the common basal part of the peduncle ought to be regarded as corresponding to the stolon in the other specimens. In colour the "Porcupine" specimen agrees well with the description given above. The head is not quite so dark, and shows a good deal of red pigment even above the equatorial line. The upper end has a considerable amount of violet and black pigment. There can be no doubt, I think, that notwithstanding the branched peduncle, the larger size, and the somewhat lighter colour, the colony from Tangier Bay must be referred to the same species as those from the Philippine Islands. It may, however, be regarded as a variety.

The pigmentation of all of these colonies agrees well with that of *Distaplia magnilarva* as described by Della Valle, and differs from that of *Distaplia rosea* where there is no dark colouring, all the pigment being rose-red. From *Distaplia lubrica*, on the other hand, our species is readily distinguished by the entirely different shape of the colony. From the external appearance and colour I should be inclined to refer the Challenger and "Porcupine" specimens to *Distaplia magnilarva*, although in Della Valle's figures[1] the heads are relatively larger and more ovate in shape and the peduncles are very much smaller, but from the small size of the Ascidiozooids and of the tailed larvæ (see below) it is impossible that they can belong to that species. The Ascidiozooids are about 2 mm. in length,[2] and are placed with the long axis extending downwards from the branchial aperture towards the peduncle. The branchial aperture, with its conspicuous white margin, is less than 0·5 mm. in diameter, and the centres of adjacent branchial apertures in the same row are placed about 1 mm. apart. (Pl. XVIII. fig. 1). In the "Porcupine" specimen the Ascidiozooids and the branchial apertures are a little larger (Pl. XVIII. fig. 2).

The test is soft and gelatinous in the centre of the colony. The outer layer is firmer, and is very considerably pigmented. The peduncle is the clearest part, but even there small patches of opaque white and dark violet or black pigment are found. The rosy tint of the upper end of the peduncle is due to the posterior ends of some of the Ascidiozooids showing through, and not to red pigment in the test.

In the head this dark pigment is almost entirely confined to the outer firmer layer of the test, the inner part being transparent and of a grey colour. The red and white and black pigmented bodies of the Ascidiozooids show through to a certain extent, and help to make the head, as a whole, more opaque. In the "Porcupine" specimen some parts of the surface layer of test contain a very large amount of red pigment (see Pl. XVIII. fig. 5, *p.c.*), resembling in this respect *Distaplia rosea*.

In its minute structure the test consists of a homogeneous matrix in which are scattered numerous small test cells and larger pigment cells (Pl. XVIII. fig. 4). The test cells are of all shapes, stellate and branched forms being common. The pigment cells are usually ovate or irregularly rounded and very opaque. They show three distinct colours: white, red, and very dark violet or black. The red and the white ones are evenly pigmented all over (Pl. XVIII. fig. 4, *r.p.c.*), while the black ones have the pigment granules usually extending over about one half of the cell, the remainder being clear (Pl. XVIII. fig. 4, *b.p.c.*).

The mantle is fairly strong over the branchial region of the body. On the viscera, however, it is very thin, but is deeply pigmented. The muscle bands are nearly all transverse in direction, and are more regularly placed than in Della Valle's figures of the Ascidiozooids of

[1] Nuove Contribuzioni, &c., Tav. i. figs. 1, 1', 4 and 4'.

[2] Della Valle gives the length of the Ascidiozooid of *Distaplia magnilarva* as 6 mm.

Distaplia magnilarva. In some specimens of *Distaplia rosea* from the Bay of Naples, which I have examined, the musculature is less marked and less regular than in the new species.

The branchial sac is remarkable on account of the large size of the stigmata (Pl. XVIII. fig. 6, *sg.*). They are long and narrow like those of *Colella pedunculata*, and are arranged with great regularity. Each row is crossed about the middle by a narrow transverse vessel or horizontal membrane (Pl. XVIII. fig. 6, *tr'*) which does not interrupt the stigmata, and is considerably thinner than the regular transverse vessel between the rows. In a specimen of *Distaplia rosea* from Naples,[1] which I have examined, the branchial sac shows precisely the structure which I find in the Challenger species (compare Pl. XVIII. figs. 3 and 6), and differs considerably from the figure given by Della Valle.[2] The latter shows, in the branchial sac, each row consisting of five short stigmata, all of the same size, and not crossed by any horizontal membrane; while I find in all the Ascidiozooids which I have examined of the Naples specimen of *Distaplia rosea*, that there are from twenty to thirty long stigmata in each of the four rows, that those in the middle of the row are the longest, the size decreasing towards each end, and especially towards the ventral end (see Pl. XVIII. fig. 3), and that each row is crossed by a distinct horizontal membrane. The rapid decrease in size of the stigmata as they approach the ventral end of the row allows the transverse vessels to enlarge rapidly into triangular areas which abut against the sides of the endostyle (Pl. XVIII. fig. 3, *tr.*). In other respects the Naples specimen of *Distaplia rosea* agrees well with Della Valle's description and figures of that species.

The dorsal languets are short, triangular, and pointed, and, like those of *Distaplia rosea*, they are not quite in the median dorsal line but slightly to one side. Della Valle states that there are no languets in *Distaplia magnilarva*.

The tentacles of *Distaplia vallii* are rather irregular in size. There are eight rather larger and some intermediate smaller and more irregularly placed ones. The larger tentacles are pigmented.

The alimentary canal is like that of *Distaplia magnilarva* in all essential characters. It is pigmented with opaque white, red, and black patches. The vascular ectodermal appendages are long.

The reproductive organs are hermaphrodite and of large size. They usually consist of one or two large opaque yellow ova and a number of ovate or sausage-shaped testes of a dull brick-red colour. The vas deferens is conspicuous, and is also coloured red.

The tailed larvæ are about 1 mm. in greatest length. They are thus about half the size of those of *Distaplia magnilarva* according to Della Valle. The body is ovate, with the usual three adhering processes in front. The larval tail is short.

On the whole *Distaplia vallii* is closely related to *Distaplia magnilarva* and to

[1] Obtained named from the Zoological Station, Naples.
[2] Nuove Contribuzioni, &c., Tav. i. fig. 9.

Distaplia rosea, and may be regarded as occupying a position between them. In general shape and pigmentation it agrees with *Distaplia magnilarva*, while it differs from that species and agrees with *Distaplia rosea* in having comparatively small Ascidiozooids and larvæ. The peduncle is rather larger than in either of Della Valle's species.

If a *Distaplia* were discovered which was related to *Distaplia magnilarva* and to *Distaplia rosea* in the reverse way to that found in the case of *Distaplia vallii*, that is, if it agreed in shape and colour with *Distaplia rosea* but possessed the large Ascidiozooids and larvæ of *Distaplia magnilarva*, then, unless it had some sufficiently important characters peculiar to itself, it would be necessary to unite the four species, and consider them merely as varieties showing all the possible combinations (AC, AD, BC, BD) of the four characters:—A, large Ascidiozooids and larvæ, B, small Ascidiozooids and larvæ, C, dark pigmentation, and D, red pigmentation. Of course such a combination as AB or CD would be impossible. The formulæ for the three known species would be *Distaplia magnilarva*, AC, *Distaplia rosea*, BD, *Distaplia vallii*, BC, and the imaginary fourth form would be AD.

Genus doubtful.

———— (?) *clava*, n. sp. (Pl. XXVII. figs. 1, 2).

A specimen found at Station 75,[1] off the Azores, cannot with certainty be referred to its proper position, as it shows no traces of Ascidiozooids. It is an elongated curved mass about 4 cm. in length and 1 cm. in average thickness, and was evidently attached by the lower end. The opposite extremity is slightly swollen and convex, and thus forms a rounded knob on the summit of a thick peduncle (Pl. XXVII. fig. 1), but the entire mass is composed of test.

The surface is rather rough, and the colour is a dark dull grey, having lighter and darker patches on the upper end (Pl. XXVII. fig. 1). It is tough and cartilaginous, and is seen on section to have the same colour and structure all through.

The test matrix appears structureless, but is densely crowded with test cells (Pl. XXVII. fig. 2, *t.c.*). These are rather large, and are mostly of more or less rounded form. They are not granular, but are usually clear, homogeneous, highly refracting, and of a yellow colour. A few fusiform and stellate cells are also present.

In some parts of the test, especially in the knob-like upper end of the specimen, large numbers of pigment corpuscles are found. They are all spherical, ovate, or ellipsoidal in shape, and are of large size (Pl. XXVII. fig. 2, *pig.*). The pigment granules, which are opaque white, are usually confined to one half of the cell. The lighter patches on the upper end of the specimen are due to the presence of very large numbers of these

[1] Station 75, July 2, 1873; lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

pigment corpuscles. Smaller pigmented cells (Pl. XXVII. fig. 2, *p.c.*) are found scattered here and there through the remainder of the test. Bladder cells are present in some places in abundance (Pl. XXVII. fig. 2, *bl.*). They are large and of the usual ellipsoidal form, and are so numerous in places as to reduce the matrix to a reticulum. In other parts of the test they are rare, and in some entirely absent. The surface layer is always free from bladder cells.

A few delicate vascular appendages are present, running downwards from the knob-like upper end, and terminating in elongated slightly swollen bulbs (Pl. XXVII. fig. 2, *v.ap.* and *t.k.*). The ectoderm cells on these vascular appendages are large and distinct.

There can be no doubt that this specimen belongs to the Ascidiæ Compositæ, although there are no Ascidiozooids present, and on account of its club-like form with the terminal knob (Pl. XXVII. fig. 1) I am convinced that it is entire, and not merely a fragment of a large colony. I believe that when obtained it was probably in a hibernating condition, and that all the Ascidiozooids had died and been ejected from the colony. In this case very probably there were some young buds connected with the vascular appendages, and lying in a dormant condition, from which new Ascidiozooids would have developed later on. Giard has shown that some of the Compound Ascidians of European seas pass into a dormant condition, accompanied by the development of pigment or calcareous spicules, on the approach of winter, and that at such a time all the old Ascidiozooids die and are ejected from the test. The presence of abundance of pigment upon the upper surface of the specimen under consideration favours the view that it was captured when in this hibernating condition.

From the general shape of the colony, and from the presence and appearance of the vascular appendages (Pl. XXVII. fig. 2, *v.ap.*), I am inclined to regard this specimen as belonging to the Distomidæ,[1] and as being probably allied to the genus *Colella*, but in the absence of Ascidiozooids it is impossible to determine even the family with precision. I believe, however, that I can state with certainty, from what is to be made out in the specimen, that it belongs to a species previously unknown.

——————— (*?*) *pyriformis*, n. sp. (Pl. XVI. fig. 17).

The Colony is more or less pyriform, but is rather variable in shape. It is attached by the narrower end, which is usually prolonged to form a short peduncle. The upper extremity is broad and rounded. The colony is usually somewhat compressed laterally. No apertures and no systems are visible. The surface is fairly smooth. The colour is a light yellowish-grey, with a tinge of reddish-brown in some places.

The length is 2·3 cm. (including 8 mm. of peduncle), the breadth is 9 mm., and the thickness 4 mm.

[1] In shape it resembles somewhat *Distoma adriaticum*, von Drasche.

The Test is soft but fairly tough. It is of a light grey colour and is semi-transparent. The matrix contains numbers of small test cells, most of which have rounded forms. Bladder cells are present in abundance in all parts of the test. There are no pigment corpuscles.

Locality.—Royal Sound, Kerguelen Island, attached to *Macrocystis pyrifera.*

Ten specimens of this small species were obtained from the fronds of *Macrocystis* at Royal Sound, Kerguelen Island. On account of the absence of Ascidiozooids from all the colonies it is impossible to refer the species with certainty to its proper position, but from the general appearance of the colony there can be little doubt that it is one of the Distomidæ, more or less closely allied to *Colella.*

The colony is always stalked, but the peduncle varies considerably in length. The shape of the body proper varies from almost spherical to a long narrow wedge-like form,[1] but the usual condition appears to be ovate or pyriform (Pl. XVI. fig. 17). There is considerable difference also amongst the specimens in the amount of lateral compression.

In most of the colonies there are no traces of Ascidiozooids, but in one or two small reddish-brown dots are visible placed in vertical rows (Pl. XVI. fig. 17), and recalling the arrangement of the Ascidiozooids in *Colella pedunculata* and *Colella murrayi.* These, however, are merely clumps of cells lying in the test, and are the remains of the missing Ascidiozooids. In one or two places tailed larvæ were found imbedded in the test beside these groups of cells. They seemed to be in a fully developed and healthy condition.

The colonies when collected were probably either in a dying condition and had lost their Ascidiozooids, or they were hibernating and the old members of the colony had been expelled from the test. In the latter case the tailed larvæ which remain may have been destined to develop, after a time, into young Ascidiozooids in the old test, without passing through a free-swimming condition, and so bring the colony back to active life; or possibly they may have been retained in the test as a protection until a more favourable season arrived for being set free before settling down and founding new colonies.

The test in its minute structure is very like that of several species of *Colella* (*e.g.*, *Colella pedunculata*, see p. 78 and Pl. V. fig. 15). The bladder cells are very delicate, but in most places they are abundant. The test cells are small, but very numerous. All shapes are found amongst them, but rounded and ovate forms prevail. In sections of the colony large spaces are found to occur here and there near the periphery. These are evidently the positions which were occupied by the Ascidiozooids. Near the centre of the sections, again, there are smaller openings in the test, which were probably filled formerly by the vascular appendages. In one or two cases the remains of the vascular appendages are to be found, but in most cases, like the Ascidiozooids, they have totally disappeared.

[1] The longest specimen is 3·5 cm. in length.

Cystodytes, von Drasche.

Distoma, Della Valle, Contribuzioni, &c. p. 40, Napoli, 1877. In part.
Distomus, Della Valle, Nuove Contribuzioni, &c., Roma, 1881. In part.
Cystodytes, von Drasche, Die Synascidien der Bucht von Rovigno, p. 18, Wien, 1883 (as a subgenus of *Distoma*).

Colony of irregular form, attached and incrusting, sometimes lobed, and of moderate thickness.

Ascidiozooids surrounded by capsules formed of calcareous disk-shaped spicules. No vascular appendages present.

Test cartilaginous, containing calcareous disk-shaped spicules.

Branchial Sac small.

Abdomen as large as thorax.

Dr. R. von Drasche, in his Synascidien der Bucht von Rovigno, distinguished two new species of Distomidæ as having a remarkable form of calcareous spicule which clearly separated them from all allied forms. On this account he divided the old genus *Distoma*, to which these new forms belong in their other characteristics, into two subgenera, *Cystodytes* and *Distoma*. Previously, however, Della Valle had described and figured[1] a form of spicule occurring in *Distoma dellechiaiæ*, from the Bay of Naples, which is apparently the same as those of *Cystodytes*. In the Challenger collection there are two additional new species which agree in all essential characteristics of generic value with v. Drasche's two species of *Cystodytes* and with *Distoma dellechiaiæ*, Della Valle, and I consider that as these five species are so clearly distinguished from other Distomidæ it will be of advantage and will simplify classification if *Cystodytes* as defined by von Drasche be considered an independent genus.

The colony is in all cases of somewhat irregular form and moderately large size. It is attached by the greater part or the whole of its lower surface, and the upper surface may be either nearly flat or raised so as to form a convex mass of moderate thickness. The species from the Adriatic are of rather greater thickness than those in the Challenger collection: *Cystodytes cretaceus* may be as much as 3 cm. in thickness.

The colour varies considerably. It may be milk-white, grey, yellow, brown, or violet. The surface is always smooth. In von Drasche's two species the Ascidiozooids are arranged in distinct systems. This is not so obvious in the Challenger species. *Cystodytes draschii* shows in some places the formation of irregular systems, but in *Cystodytes philippinensis* there seems to be no definite arrangement. The most characteristic feature of the genus is the formation, around the greater part of the body of each Ascidiozooid, of a calcareous capsule formed of separate discoidal plates which

[1] Nuove Contribuzioni, &c., p. 23, Tav. ix. figs. 98, 99.

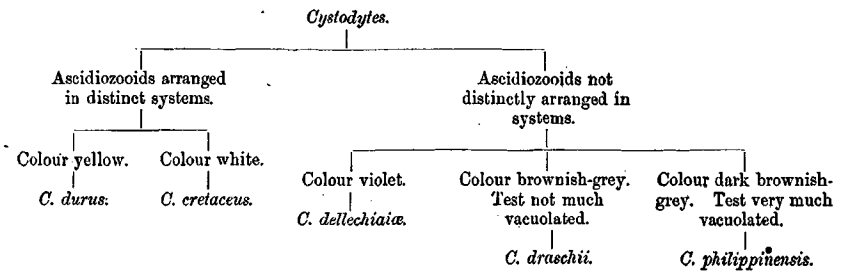
are developed in the test (Pl. XIX. fig. 7). These peculiar spicules are described more fully in the account of the species given below, but they seem very similar in all the five known species, and are quite unlike any other form of spicule found in the Tunicata.

The test is always more or less cartilaginous in consistence, and contains large numbers of bladder cells. The mantle is moderately strong, and the branchial and atrial siphons are both of good size and are six-lobed at their openings. The atrial siphon apparently may vary considerably in form. Von Drasche states that the shape differs in different specimens of *Cystodytes durus*, and the forms I have figured (Pl. XIX. fig. 11, *at.*, and Pl. XX. fig. 7, *at.*) for *Cystodytes draschii* and *Cystodytes philippinensis* are very dissimilar. Common cloacal apertures are always present.

The stigmata in the branchial sac are always of rather small size, and are not very numerous. The tentacles, so far as is known (they are not described by von Drasche), are exceptionally long and numerous. The stomach is always smooth walled. The reproductive organs are hermaphrodite.

The five known species of *Cystodytes*, though agreeing in all the above characters, may, I think, be readily distinguished. In colour they differ considerably. *Cystodytes dellechiaiæ* is violet, *Cystodytes durus* is of a distinct yellow colour, *Cystodytes cretaceus* is milk-white, *Cystodytes draschii* is of a brownish-grey, and *Cystodytes philippinensis* is rather darker than the last. *Cystodytes durus* and *Cystodytes cretaceus* form decidedly thicker colonies than *Cystodytes draschii* and *Cystodytes philippinensis*. *Cystodytes durus* and *Cystodytes cretaceus* have the Ascidiozooids arranged in distinct systems, and, judging from von Drasche's figures, this is especially the case in *Cystodytes durus*, where the systems are obvious and very clearly circumscribed. In the two new species no such distinct arrangement is found, and in *Cystodytes dellechiaiæ*, according to Della Valle, the systems are not well-marked. On the whole the new species are nearer to one another than to any of those previously known, which are very clearly distinguishable by their colours (see von Drasche's beautiful plates). The detailed comparison of the two new species will be given below under *Cystodytes philippinensis*.

The five species may briefly be distinguished by the following characters :—



Cystodytes draschii, n. sp. (Pl. XIX. figs. 1–15).

The Colony is of a rudely elliptical shape, flat, and incrusting, and is of moderate thickness. The colour is of a dull brownish-grey, darker in the centre and more transparent round the edges. The surface is uneven, but smooth and glistening. The common cloacal apertures are inconspicuous.

The length is 6 cm., the breadth is 3 cm., and the average thickness is 5 mm.

The Ascidiozooids are somewhat elongated antero-posteriorly, and are placed nearly always at right angles to the surface. The usual size is 3 mm. antero-posteriorly, and 2 mm. dorso-ventrally and laterally. The anterior end is rather narrow, and terminates in the branchial aperture, while the posterior is broad and rounded. The posterior three-fourths or so of the Ascidiozooid is encased in a capsule formed by disk-shaped calcareous plates closely placed or overlapping. The anterior end projects from this calcareous capsule, and is free and unprotected.

The Test is soft but firm. It is very smooth on the upper surface. It is fairly transparent, especially near the edges. It is of much the same thickness throughout, and the edges are prominent and rounded. The test consists of a clear homogeneous matrix, which is greatly broken up by the presence of numerous large bladder cells, and contains great numbers of smaller cells of various shapes. Near the surface, for a short distance, the test is compact, and contains no bladder cells, but throughout the rest of its extent it is vesiculated. Around the bodies of the Ascidiozooids are formed in the test the discoid spicules which compose the calcareous capsule.

The Mantle is fairly muscular. The muscle fibres are delicate but numerous, and they form a close network. Transverse and longitudinal bands are equally numerous.

The Branchial Sac is small and rather thick walled. The transverse vessels are all of the same size. The stigmata are comparatively small.

The Tentacles are very long and narrow. There are about fifty of them, and they are of two sizes, long and short, placed alternately.

Locality.—Off Barra Grande; depth, 400 fathoms.

A single specimen of this interesting species was obtained off Barra Grande, Brazil, on the 10th September 1873, from a depth of 400 fathoms. It is a flat expanded colony of considerable size (Pl. XIX. fig. 1). The edges are generally thick and rounded, but in some places slightly expanded thin margins are present. The upper surface is nearly flat; here and there, however, it is slightly raised into small rounded knobs and ridges which give an equally distributed unevenness to the whole. This upper surface is very smooth and glistening. The lower surface is rough and rather irregular; it has evidently all served as an adhering area with the exception of a slight margin, which is in some places 5 mm. wide.

The colour on the upper surface varies from yellowish-grey to various shades of brownish-grey. It is lightest on the edges where composed of test only. The bodies of the Ascidiozooids show through indistinctly (Pl. XIX. fig. 1) as opaque light coloured rounded spots.[1] The common cloacal apertures are fairly numerous but not conspicuous. They are irregularly scattered. The under surface of the colony is rather lighter coloured than the upper, but is more opaque-looking, probably on account of the absence of the very transparent glistening superficial layer of test found on the upper surface. The Ascidiozooids are placed nearer to the lower surface, and their white calcareous capsules show through more distinctly than they do on the upper surface.

The Ascidiozooids seem to be to a certain extent arranged in systems of five or six together, but these are by no means regular. Although the branchial apertures are all on the one surface of the colony, and the posterior ends are all placed nearest to the other surface, still the Ascidiozooids are not regularly arranged perpendicularly to the upper surface; consequently, in a vertical section of the colony (such as Pl. XIX. fig. 4), they may be cut at various angles. The shape of the Ascidiozooid is remarkable (Pl. XIX. figs. 4, 5), but it must be remembered that it is mainly due to the presence of the thick calcareous capsule which encloses the posterior end, and which, although it adheres closely to the Ascidiozooid as dissected out from the colony, really belongs to the common test in which it is produced.

The test varies somewhat in structure in the different regions of the colony. Figure 2 shows a section extending from the outside (on one of the margins) for a considerable distance inwards. The outer layer is seen to be free from bladder cells, and to have scattered in the matrix merely the ordinary rounded fusiform and stellate cells. These are comparatively large and numerous. Then as the section is traced inwards, bladder cells make their appearance and rapidly become very abundant,—even more abundant in some places than appears from the figure. They are large, spherical or ellipsoidal in shape, and have distinct nuclei adhering to one part of the wall. In the narrow bars of test matrix left between these bladder cells, the small fusiform and stellate cells are still found. This is the region of the test where the bladder cells are most abundant. Further in towards the centre of the colony they become less numerous, although they are always fairly abundant. The small test cells continue to be thickly scattered in all parts of the colony (Pl. XIX. figs. 2, 3, *t. c.*).

In the deeper parts of the test, away from the margins, are found groups of rounded cells with very large distinct nuclei (Pl. XIX. fig. 2, *t. c.'*), and occasionally a small calcareous spicule may be found in the centre of such a clump. These indicate the mode of origin of the remarkable calcareous capsules enclosing the Ascidiozooids. The small fusiform or branched test cells may apparently in this genus either develop into large bladder cells,

[1] The upper surface of the single specimen presents rather a curious appearance in some parts from small air-bubbles having gained access to spaces (the cloacal cavities) under the surface layer of test.

or they may proliferate, in the neighbourhood of the Ascidiozooids, to form the groups of closely-placed cells with large nuclei. These cells then deposit between them a calcareous spicule, around which they are, when it is completed, stretched in the form of a thin membranous capsule containing nuclei. Such a capsule may be readily stained in the case of most of the large discoid spicules, and is sometimes seen hanging loosely from fragments of broken spicules. The nuclei are very like those of the rounded cells in figure 8, and intermediate conditions may be found covering the smaller spicules.

The calcareous capsule around the Ascidiozooid is formed of a large number of circular disks placed vertically in the layer of test immediately surrounding it (Pl. XIX. fig. 3, *sp.*). The disks are in most parts so numerous as to overlap one another's edges (Pl. XIX. fig. 7), and are on an average 0·4 mm. in diameter. Each disk is thickest in the centre, and tapers towards the circumference. This, as well as the general arrangement, may be seen from the transverse section of an Ascidiozooid and the neighbouring part of the common test shown in figure 3. It is also seen that the capsule is by no means a regular uniform covering, but is thick in some places (where it may be five or six spicules deep), and thin or absent in others. Some of the disks are not perfectly flat, but are slightly curved, as seen in section, and are placed with the concavity towards the body of the Ascidiozooid. In the cases of a few of the spicules in the figure (Pl. XIX. fig. 3, *sp.*), the capsule is seen to fit very loosely, leaving a large open space between itself and the enclosed spicule. Whether this is natural, or a result of the method of preservation and after-treatment, it is difficult to say. The disks, when seen in surface view as in figures 6 and 7, are beautifully marked by delicate concentric bands and by radiating lines. The latter in many cases go in groups, being absent or more openly placed in particular regions of the spicule, and closer in others (Pl. XIX. fig 6).

The mantle is of considerable strength. The musculature over the greater part of it is in the form of a close network formed by strong bundles of longitudinal and transverse bands running at right angles, and forming narrow quadrangular meshes (Pl. XIX. fig. 9). When these muscle bands reach the anterior end they become the radiating and circular bundles which surround the branchial aperture in a somewhat irregular manner (Pl. XIX. figs. 10, 11). The branchial sphincter is well developed and compact. Beyond it for a short distance the radiating muscle fibres are not collected into bundles, but form an evenly distributed layer which passes outwards, crossing several series of circular fibres. Further out, however, the radiating fibres become grouped together into definite bundles separated by clear spaces free from muscle fibres (Pl. XIX. fig. 10), and these bundles are continued down the sides of the body, as the longitudinal bands of the network shown in figure 9. The muscular fibres throughout the greater part of the mantle are very narrow, but in some places fibres of considerable size, up to 0·004 mm. in breadth, are met with. There are many variously shaped connective tissue cells with very large distinct nuclei scattered through the mantle (Pl. XIX. fig. 10).

The branchial aperture is distinctly six-lobed, and the whole branchial siphon is considerably pigmented of a reddish-brown colour (Pl. XIX. fig. 10). The atrial aperture is prolonged into a long narrow siphon which opens into the common cloacal cavity (Pl. XIX. fig. 11, *at.*).

The branchial sac is thick and opaque. The stigmata are small and not very numerous. The endostyle is large and has a serpentine course (Pl. XIX. fig. 3, *en.*).

The tentacles are very numerous, remarkably so for a Compound Ascidian, and are also, some of them, singularly long and narrow. Their bases are closely placed (Pl. XIX. fig. 12). They have all the appearance of being extensile and retractile, as some portions of them have a stretched out appearance (Pl. XIX. figs. 12, 13). Some of the epithelial cells on the surface of the tentacles are large and fusiform, with very large central ovate projecting nuclei. These cells are placed generally in little groups, with their long axes pointing along the tentacle. On the edges of the tentacle, as seen under a high magnification (about 1000 diameters), the nuclei form rounded projections of considerable size (Pl. XIX. fig. 13). At the extreme tip of the tentacle these cells are much more numerous, and cover almost the whole surface, the nuclear projections giving it quite a rough knobbed appearance (Pl. XIX. fig. 14).

The alimentary canal occupies the broad rounded posterior end of the Ascidiozooid. The stomach is large and globular, and is smooth on the outer surface. The intestine is short. A few tailed larvæ were found in the colony; the single pigmented sense organ is placed near the posterior end of the body, the endostyle is large, and they are in many ways very like those of *Colella pulchra* (compare Pl. XIX. fig. 15, and Pl. XV. fig. 12).

Cystodytes philippinensis, n. sp. (Pl. XX. figs. 1–12).

The Colony is of irregular form, flat and incrusting, and of moderate thickness. The colour is dark brownish-grey, rather lighter round the edges. The surface is uneven but fairly smooth. The common cloacal apertures are inconspicuous.

The length is 4 cm., the greatest breadth is 3 cm., and the thickness about 5 mm.

The Ascidiozooids are elongated antero-posteriorly, and are usually placed at right angles to the surface. The usual size is 2·5 mm. antero-posteriorly, and slightly more than 1 mm. in greatest breadth. The anterior end is slightly narrower, and terminates in the branchial siphon, while the atrial projects from its dorsal extremity. The posterior end of the body is broad and rounded. The posterior half or three-fourths of the Ascidiozooid is concealed by a calcareous capsule formed of disk-shaped spicules. The anterior end projects from this capsule and is quite unprotected.

The Test is firm and rather stiff. It is smooth on the upper surface, and is moderately transparent. It does not vary much in thickness, and the edges are prominent and rounded. The matrix is clear and homogeneous, but it is greatly reduced and

broken up by the presence of innumerable bladder cells which in most places are so abundant as to become polygonal by mutual pressure, and reduce the matrix to a system of mere bands and membranes separating the cavities from one another. The usual small variously shaped cells are abundant all through the test. In the neighbourhood of the Ascidiozooids are found the large discoid spicules which form the calcareous covering.

The Mantle is strong and has a well-developed musculature. The muscle fibres are large and numerous, and form a close network. They run in all directions.

The Branchial Sac is small and thick walled. The transverse vessels are wide and all of one size. The stigmata are rather small. The fine longitudinal vessels are narrower than the stigmata.

The Tentacles are numerous and rather long.

Locality.—Samboangan; depth, 10 fathoms.

Of this species of *Cystodytes* three small colonies were obtained off Samboangan in the Philippine Islands, from a depth of 10 fathoms. It is closely allied to the last described species, but they differ in a number of details which are pointed out below.

Like *Cystodytes draschii* this is a flat or nearly flat expanded incrusting colony, which is probably attached to foreign objects by the greater part of its lower surface. It is of quite irregular shape (Pl. XX. figs. 1, 2), and grows out into rounded lobes. The margin is thick and projecting as in the last species, but it is more irregular and not so transparent. A slight expanded thin margin is present at one or two points. The upper surface is undulating, and has besides numerous very slight elevations which correspond to the anterior ends of the Ascidiozooids. It is smooth and somewhat glistening, but not so much so as in the case of *Cystodytes draschii*. The lower surface (Pl. XX. fig. 2), on the contrary, is not so rough as in the previous species. It is, however, very irregular, and has various foreign bodies—sand-grains, shell fragments, and Polyzoa—adhering to it. There is a slight rounded margin, varying from 2 mm. to 5 mm. in thickness, round the greater part of the edge (Pl. XX. fig. 2), which evidently did not adhere.

The colour is distinctly duller and darker than in *Cystodytes draschii*, and has none of the yellowish tinge found in that species, otherwise it is similar. The Ascidiozooids show through in the same indistinct manner (Pl. XX. figs. 1, 2), but form smaller light-coloured areas than in the previous species. The under surface is scarcely at all lighter in colour than the upper, and the Ascidiozooids do not show through so distinctly on this surface. In short the Ascidiozooids altogether are rather less conspicuous in this species than in the last.

In a section the Ascidiozooids are seen to be mostly placed vertically in the colony (Pl. XX. fig. 3); some, however, are inclined. No arrangement in systems can be distinctly made out. The general shape of the Ascidiozooid and its relation to the surrounding calcareous capsule (Pl. XX. figs. 3, 5) is the same as in *Cystodytes draschii*.

The branchial siphon is small and is placed at the anterior end of the body. The atrial siphon is rather on the dorsal edge. It is large (Pl. XX. fig. 7, *at.*), but is shorter and rounder than that of *Cystodytes draschii*.

The test, although its general structure is the same as in the last species, is considerably more vacuolated (see Pl. XX. figs. 5, 6, 9, 12). This is due to the very great abundance of the bladder cells. The superficial layer of the colony has none (Pl. XX. fig. 6), but all the rest of the test is occupied by them to such an extent that the matrix is almost entirely absent (Pl. XX. fig. 9). All that is left is the system of membranes and delicate trabeculæ which bound the large polygonal bladder cells. In these trabeculæ lie the small fusiform test cells (Pl. XX. fig. 6, *t.c.*), and along their edges are placed the parietal nuclei of the large bladder cells. Under a low power (50 diameters) a section of the test shows generally several adjacent layers of the polygonal cells intersecting one another so as to form an irregular meshwork (Pl. XX. fig. 9), while the whole is thickly peppered over with minute dots, the nuclei of the cells. A higher magnification (Pl. XX. fig. 6) shows the individual bladder cells more clearly, and allows their nuclei to be distinguished from those of the unmodified test cells in the reduced matrix. This whole structure is singularly like that of the test of *Colella pedunculata* (see p. 78), as may be seen by comparing Plate XX. figure 6 with Plate V. figures 14, 15. It is clearly an extreme form of the modification commenced in the test of *Cystodytes draschii*, and seen, though to a much less extent, in one part of figure 2 on Plate XIX. Groups of rounded cells with large nuclei are present in the neighbourhood of the Ascidiozooids (Pl. XX. fig. 5).

The calcareous capsule enclosing the Ascidiozooid, as in the case of the last species, really belongs to the neighbouring part of the colonial test (Pl. XX. fig. 5). It consists of a number of large discoid calcareous plates which lie vertically and are somewhat irregular in distribution, being in some places more numerous than they are in others. These disks are rather larger than in the last species, being on an average 0·5 mm. in diameter. They are also very much thicker, as a comparison of Plate XX. figures 4, *B*, and 5, and Plate XIX. figure 3, showing the edges of both, will show. Otherwise the shape in the two species is the same. In surface view, however, the spicule in the present species seems, doubtless on account of its greater thickness, much stronger and more opaque (Pl. XX. fig. 4, *A*). The minute markings on the spicule and the method of its formation seem to be much the same in both cases.

The superficial layer of the test seems not to adhere[1] to the anterior portions of the Ascidiozooids, and can readily be torn off from the colony. It then, when slightly magnified, presents the appearance shown in Plate XX. figure 10. The branchial apertures (*br.*) are distinct rounded apertures. They are usually not quite circular, but have a

[1] It must be remembered that the specimens I examined had all been preserved in alcohol. Doubtless when living the mantle and test adhere throughout.

more or less well-marked pentagonal or hexagonal (usually the latter) form. The test for a short distance around the branchial aperture is very thin and transparent, and thus a circular light coloured area around the aperture is produced (Pl. XX. fig. 10). I regard this (the region between *br.* and *br.si* in fig. 10) as the thin layer of test which turns in at the branchial aperture and lines the branchial siphon. So that, according to this view, although *br.* is the actual aperture in the test through which water, &c., enters the branchial sac, *br.si* indicates the apparent edge of the branchial aperture on the outside of the body. The diagrammatic vertical section given in Plate XX. figure 11 shows this more clearly. The remainder of the surface layer of test, although still thin, is a good deal thicker and less transparent than the part lining the siphon. The area occupied by each Ascidiozooid is clearly marked out and separated from the neighbouring areas by a projecting ridge with a broken top, forming an irregularly hexagonal figure (Pl. XX. figs. 10, 11, *t.*). This is simply the test matrix left between the various Ascidiozooids (Pl. XX. fig. 12, *t.*), and it is merely this comparatively narrow ridge which is torn across in removing the superficial layer of test. It tears along the dotted line in the diagrammatic section (Pl. XX. fig. 11, *t.*). Lower down this ridge expands (Pl. XX. fig. 12) into the general test mass of the lower part of the colony in which the calcareous spicules are formed. The large cavities enclosed by the ridges projecting inwards from the surface contain the anterior parts of the Ascidiozooids. In the alcoholic specimens these latter have contracted greatly, and as a result of this in most cases the branchial siphon has been drawn downwards towards the posterior or lower part of the cavity, allowing a free passage from the outside into the cavity in the test. This is shown by the arrow in the middle of the diagrammatic figure (Pl. XX. fig. 11). If the specimens are taken out of the alcohol for a few minutes small air-bubbles enter in this manner and give a very remarkable appearance to the upper surface of the colony.

The mantle is thick and strong. The muscle fibres are in most parts both numerous and of large size; they form a close network (Pl. XX. fig. 7). Longitudinal and transverse bands are equally well developed. The sphincters are not specially powerful.

The transverse vessels of the branchial sac are nearly as wide as the stigmata are long (Pl. XX. fig. 8). The stigmata though short are regularly arranged.

The tentacles are very numerous, their bases touch. They are many of them long, but not so narrow as in the last species. Various sizes are seen, but there appears to be no regular arrangement.

The colony as a whole is stiffer and more brittle than in *Cystodytes draschii*. This is, I believe, due to the stronger calcareous spicules and to the extreme vacuolation of the test. The calcareous investments of the Ascidiozooids are also whiter and more conspicuous than in the case of the last species.

Symplegma,[1] n. gen.

Colony formed of several ovate heads connected by branched peduncles.
Ascidiozooids moderately large, not much elongated, and not divided into regions.
Test firm, vessels numerous.
Branchial Sac large and well developed, provided with internal longitudinal bars.
Dorsal Lamina in the form of a plain membrane.
Alimentary and Reproductive Organs forming a mass projecting for a short distance behind the branchial sac.

This genus is formed for a very remarkable species, which, while belonging probably to the Distomidæ, shows certain characters which are not found elsewhere in that family, and on the other hand are characteristic of the Botryllidæ. These are the highly vascular test (see Pl. XVIII. figs. 8, 9), the presence of internal longitudinal bars in the branchial sac (Pl. XVIII. figs. 10, 12), the absence of languets on the dorsal lamina (Pl. XVIII. fig. 13), and the want of a well-marked abdomen. In general appearance and structure the colony is a *Colella* (see Pl. XVIII. fig. 7), and looks not unlike *Colella concreta* and *Colella ramulosa*, but the above mentioned characters—especially the structure of the branchial sac and of the dorsal lamina—are so remarkable and important that it is necessary to form a new genus. There is only one colony in the collection. It was obtained in shallow water off Bermuda.

Symplegma viride, n. sp. (Pl. XVIII. figs. 7–14).

The Colony is composed of ovate or elongated masses connected by branched peduncles. The head varies greatly in form, but is always narrow at its lower end, where it tapers gradually into the top of the peduncle. The colour of the head is a dull green with spots of reddish-brown scattered here and there. The peduncle is of a dull greyish-yellow colour. The surface is uneven and not smooth.

The length of the head is 1·2 cm., the greatest thickness is 0·7 cm., the length of the peduncle is about 1·5 cm., and its thickness 0·3 cm.

The Ascidiozooids are fairly large, and are so numerous as to occupy nearly the whole surface of the head. They show as ovate projections about 2 mm. in greatest length. They are not much elongated antero-posteriorly, and are not placed at right angles to the surface, but incline from the anterior end downwards and inwards towards the top of the peduncle.

The Test is small in quantity. It is rather hard and firm, and is not transparent. It is of a dull green colour. The matrix is firm and homogeneous, but is penetrated by

[1] σύμπλεγμα.

vessels of considerable size, with swollen end-bulbs filled with blood-corpuscles. The cells in the matrix are very few in number, and of small size.

The Mantle is strong. The muscle bands are not large, but they are very numerous and run in all directions, forming a close but very irregular network. The blood-corpuscles are of a dark green colour, and give the mantle a very decided tint.

The Branchial Sac is large, and has a number of stigmata. Internal longitudinal bars are present, and they divide the inner surface into meshes. The transverse vessels are all exceedingly narrow. The stigmata are large and regularly arranged; they are about equal in width to the fine longitudinal vessels between them.

The Tentacles are of moderate size, and are all of the same length. They are eight in number.

The Dorsal Lamina is a plain narrow membrane with no ribs nor teeth.

The Dorsal Tubercle is a small circular aperture placed in a deep triangular peritubercular area.

The Alimentary Canal is small, and does not extend far behind the branchial sac.

The Reproductive Organs are placed alongside the alimentary canal.

Locality.—Off Bermuda; shallow-water.

This is an interesting and important form on account of the resemblances it shows to the Botryllidæ on the one hand and to the Distomidæ on the other. It is possible that when its structure has been more minutely examined in better preserved and more abundant material it may prove to be more closely allied to the Botryllidæ than it is to the Distomidæ. A single specimen only is present in the collection. It was obtained off Bermuda, in shallow water. It consists of about ten heads connected by narrow branched peduncles, and closely united to a group of Sponges, Polyzoa, and other foreign objects, the whole forming a tree-like mass about 10 cm. in height and 2·5 cm. in greatest breadth (Pl. XVIII. fig. 7). Unfortunately the specimen is in bad condition and is evidently very much shrivelled and distorted, consequently it is impossible to get a correct idea of the external appearance.

The heads vary greatly both in size and shape. The largest is almost 2 cm. in length, but is rather narrow; others are short and broad. The dimensions in the above description are taken from a medium sized head. The top is usually wider than the base, and is more or less rounded. The sides are not flattened. The lower end of the head tapers downwards to the peduncle, which is relatively narrow (Pl. XVIII. fig. 7). The surface of the head is rendered very uneven by the shrivelling of the test between the Ascidiozooids. The colour of the colony is peculiar. The head is a dull sage green with a few reddish-brown, or, in some cases, dull orange markings. The peduncle is usually a sort of buff or dull yellowish-grey colour.

The Ascidiozooids are numerous and closely placed. They form little rounded projections all over the surface of the head, but probably were not so prominent when in a living condition. The orange marks present in some places are caused by the alimentary viscera showing through; usually they are not visible. In most of the Ascidiozooids the branchial aperture can be made out as a small light-coloured dot. The rest of the body of the Ascidiozooid is dark green. It lies obliquely in the test, its posterior end pointing downwards to the base of the colony as well as sloping inwards a little towards the centre of the head. The viscera are placed close behind the branchial sac, so there is not much antero-posterior elongation in the body. Most of the branchial part shows at the surface, and varies in length from 1 mm. to 2 mm. Some young Ascidiozooids of small size are present in the colony.

The test is remarkable on account of its very limited amount, its toughness, its comparative want of cell elements, and its well developed system of blood-vessels (Pl. XVIII. fig. 8). Between the Ascidiozooids there is merely a thin layer of test, and there is not much more present in the centre of the head. This is probably due to a great extent to the shrunken condition of the colony. Most of the heads are flattened laterally, but I am of opinion that this is not the natural shape, but is due to distortion during the process of preservation. Possibly the strength and firmness of the test is also unnatural. The matrix is apparently structureless, and contains very few cells. The blood-vessels are numerous and large. They branch freely (Pl. XVIII. figs. 8, 9) and have swollen terminations. In some places near the surface they are found to form by branching and anastomosing systems of small meshes, from which are given off numbers of swollen bulbs on the side next the surface (Pl. XVIII. fig. 9). Nearly all the vessels contain large quantities of blood-corpuscles, most of which are of a green colour. The terminal knobs are, as a general rule, not greatly swollen (Pl. XVIII. fig. 8, *t.k.*), being more of a club-shape than the ovate form found in many other Ascidians.

The mantle has a peculiar form of musculature. The bands are thin, and in some places very delicate, but they are exceedingly numerous, and form a close reticulation. On both siphons the sphincters are very strong, and numbers of muscle bands radiate from under them over the neighbouring parts of the mantle, forming with the other irregularly running bundles of fibres a very close network. There is a good deal of pigmentation in the mantle, the lacunæ being in many places filled with dark green blood-corpuscles.

The branchial sac is large and well developed. It is very like the sac of some of the Botryllidæ, and it has internal longitudinal bars. These are rather broad but very thin membranes, which are not placed at regular distances, and apparently vary in number. In a very young sac (Pl. XVIII. fig. 12) three bars (the usual number in the Botryllidæ) were found upon one side, but in some of the adult branchial sacs (Pl. XVIII. fig. 10) only two bars were present upon each side.

The meshes are irregular in size and shape, on an average each contains about four

stigmata (Pl. XVIII. figs. 10, 12). The transverse vessels vary a little in size, but are always very narrow. In some cases they are so small as to be reduced to an undulating vessel winding between the ends of the adjacent interstigmatic vessels (Pl. XVIII. fig. 11, *tr.*).

The stigmata are rather long and narrow in the fully developed sac (Pl. XVIII. fig. 10, *sg.*). In the young state they are short and rounded (Pl. XVIII. fig. 12, *sg.*), and all intermediate forms may be found. In some places the branchial sac is of an opaque green colour from the numbers of blood-corpuscles contained in the vessels. The endostyle is long and narrow, and takes a straight course. It is not very conspicuous.

The dorsal lamina is remarkable on account of its having no languets. It is a perfectly plain and rather narrow membrane (Pl. XVIII. fig. 13, *d.l.*), which is formed anteriorly by the junction of the right and left halves of the peripharyngeal band (Pl. XVIII. fig. 13, *p.p.*). The dorsal lamina is exactly like the internal longitudinal bars of the branchial sac, but is a good deal wider.

The tentacles are like those of some species of *Colella*. They are not numerous, and are all of one size. They are attached to a very thick muscular band which encircles the base of the branchial siphon, and bounds the prebranchial zone anteriorly (Pl. XVIII. fig. 13, *sph.*), while it forms the posterior end of the branchial sphincter.

The aperture of the dorsal tubercle is small, but has a thick lip surrounding it. It is placed nearly at the angle of a very deep triangular peritubercular area (Pl. XVIII. fig. 13, *d.t.*), which is formed by the peripharyngeal bands bending posteriorly to join the anterior end of the dorsal lamina.

The alimentary and reproductive viscera form an opaque yellowish mass placed alongside the posterior part of the branchial sac and projecting very little beyond it. The œsophagus is narrow. The stomach (Pl. XVIII. fig. 14, *st.*) is large and globular. It lies with its long axis directed dorso-ventrally. It is ridged internally and has a small curved horn-like cæcum (Pl. XVIII. fig. 14, *cæ.*) projecting from the anterior part of its ventral end. The intestine is wide. It curves ventrally and anteriorly, and then after running for a short distance dorsally it crosses the œsophagus, and turning anteriorly again becomes the rectum, which runs up the dorsal edge of the branchial sac to open into the peribranchial cavity near to the atrial aperture.

In structure and course, as well as in position, the alimentary canal resembles that of some of the Botryllidæ. The reproductive organs are hermaphrodite, and consist of one or two large clear yellow ova and an irregular mass of small spermatic vesicles.

A number of tailed larvæ were found in the colony. They are rather small, and have short rounded bodies. Two pigmented sense organs are present.

Family III. POLYCLINIDÆ.

Colony usually massive; sometimes incrusting, sometimes lobed, or even pedunculated.

Systems of various shapes, sometimes very irregular or absent. Common cloacal apertures usually inconspicuous.

Ascidiozooids always elongated antero-posteriorly, and usually divided into three distinct regions.

Test gelatinous or cartilaginous, sometimes rendered stiff by imbedded sand-grains.

Branchial Sac usually small, and not highly developed. Stigmata usually small.

Dorsal Lamina represented by a series of languets.

Tentacles generally small and not numerous.

Alimentary Canal extending considerably beyond the branchial sac posteriorly.

Reproductive Organs placed behind the intestinal loop. Testis represented by a number of small spermatic vesicles attached to a large vas deferens.

Gemmation from the post-abdomen.

This large family, including an immense number of species, was founded by Giard in 1872. It includes five of Savigny's genera, viz., *Aplidium*, *Polyclinum*, *Sidnyum*, *Synoicum*, and *Sigillina*, all of which may still be retained either as genera or subgenera. Milne-Edwards in 1841 recognised that these forms, to which he added a sixth, *Amaroucium*, composed a natural group characterised by the shape of the Ascidiozooid. They constitute his 1re tribu, Polycliniens, which is practically, after the removal of the genus *Sigillina*, Giard's family Polyclinidæ. Milne-Edwards' *Amaroucium* is probably, as Giard suggests, the same as Savigny's *Aplidium*, Milne-Edwards having had the advantage of working at living material discovered the common cloacal apertures which Savigny who examined preserved specimens only had regarded as being absent.

Alder in 1863 employed the genus *Parascidia* (which had been previously suggested by Milne-Edwards) for the reception of three species resembling *Sidnyum* in all points except that they have an eight-lobed in place of a six-lobed branchial aperture. This genus has not been recognised or discussed by any subsequent writer. Its relations to *Circinalium* and *Fragarium*, afterwards founded by Giard (see below), must be very intimate.

Giard in 1872 formally raised the Polyclinidæ to the rank of a family, from which, however, he excluded *Sigillina*, a retrograde step, since that genus is certainly more nearly allied to *Polyclinum* than to any of the Distomidæ. Giard added a number of new species to the family, and established as new genera or subgenera *Fragarium*, *Circinalium*, and *Morchellium*. His classification of the family appears to be as follows:—

	Genus.	Subgenus.
Polyclinidæ, ...	*Aplidium.*	*Aplidium.* *Amaroucium.* *Fragarium.* *Circinalium.* *Morchellium.* *Sidnyum* (?).
	Polyclinum.	*Polyclinum.* *Aurantium.* *Sidnyum* (?).

It is not very clear whether he regards *Sidnyum* as coming under the genus *Aplidium* or the genus *Polyclinum*, and he does not state where he places *Synoicum*.

Von Drasche, writing in 1883, virtually endorses Giard's classification. He accepts the two main generic types *Aplidium* and *Polyclinum*, places *Sidnyum*, *Synoicum*, and *Sigillina* as subgenera under *Aplidium*, and recognises no subdivision in *Polyclinum*. The restoration of *Sigillina* to the Polyclinidæ constituted, however, a distinct advance upon Giard's scheme. Later on in the same year von Drasche[1] founded a new subgenus of *Aplidium*, *Polyclinoides*, for a species from Mauritius. The affinities of this form will be discussed further on.

Verrill's *Macroclinum*[2] seems not to be sufficiently distinct to require a separate genus. It contains a single species, *Macroclinum crater*, Verrill, from the Banks of Newfoundland. More information in regard to this form is required before it can be referred with certainty to its proper position.

The shape of the colony in this family is exceedingly varied. It is usually irregular and massive, and is frequently lobed on the upper surface. In some cases (*e.g.*, *Pharyngodictyon mirabile*, Pl. XXI. figs. 1, 2, 3) the lower part of the colony next to the point of attachment becomes prolonged to form a peduncle; while in others (*e.g.*, *Psammaplidium effrenatum*) the colony becomes flattened and forms a thin incrusting layer. It is comparatively rare amongst the Polyclinidæ to find the systems conspicuous and distinctly circumscribed as they are in the Botryllidæ. In most cases they are so irregular that it is impossible to make out their limits in specimens preserved in alcohol, and very generally the common cloacal apertures if present are not visible. It was this circumstance which led to the establishment of *Amaroucium* as a generic name (see under *Amaroucium*, below).

The Ascidiozooids of the Polyclinidæ are very characteristic. They are usually of large size, and are greatly elongated antero-posteriorly. The intestinal loop extends for a considerable distance behind the branchial sac, forming the region distinguished by Milne-Edwards as "abdomen," but the length of the body is in most cases mainly due to the long "post-abdomen," which extends behind the intestinal loop and contains the

[1] Ueber eine neue Synascidie, *Verhandl. d. k. k. zool.-bot. Gesellsch. Wien*, Bd. xxxiii. p. 119.

[2] *Amer. Journ. Sci. and Arts*, 3rd series, vol. i. No. 4, p. 288, 1871.

reproductive organs and the heart (see fig. 3 on p. 16). The length of the post-abdomen is very variable (compare Pl. XXVIII. fig. 2 with Pl. XXX fig. 13), and as pieces may become detached from its end in the form of buds, it is obvious that the size may vary not only in different Ascidiozooids of the same colony, but even in the same Ascidiozooid at different times. The post-abdomen is composed of an outer layer of ectoderm covering a narrow sac-like prolongation of the connective tissue and muscle bands of the mantle. This sac contains a mass of mesoderm cells, and is divided into two parts by a double median partition or septum (Pl. XXIX. fig. 11), which, according to Kowalevsky,[1] is a prolongation of the posterior end of the branchial sac.

The test varies greatly in its texture. It may be soft and gelatinous as in *Polyclinum molle*, firm and cartilaginous as in *Atopogaster gigantea*, or tough and leathery as in *Amaroucium albidum*. In some cases, when it would otherwise be soft, its appearance and character are totally changed by the numerous sand-grains and other foreign bodies attached to its surface and even imbedded in its interior. A number of the new forms discovered during the Challenger Expedition have the test in this curious condition (see Pl. XXXI. fig. 9). They form the genus *Psammaplidium*.

The mantle is well developed, and the musculature is usually of moderate strength. There is great variability in the arrangement of the muscle bands. In some cases they are all longitudinal in direction, while in others the chief bands run circularly around the thorax. In the post-abdomen they are always longitudinal. The branchial aperture is usually very distinctly six-lobed (Pl. XXXI. fig. 3), rarely eight-lobed (*Morchellioides affinis*, Pl. XXIV. fig. 19) or nearly circular (*Aplidium fuscum*, Pl. XXVIII. fig. 10). The atrial aperture may be six-lobed, but is more usually circular, or provided with a single large lobe placed on its anterior edge and known as the atrial languet (Pl. XXIX. fig. 10, *at.l.*). This languet may be placed considerably in front of the atrial aperture (as in von Drasche's *Polyclinoides diaphanum*, see also Pl. XXXI. fig. 3), and in that case the margin of the aperture is circular and unlobed. There is seldom any well-marked atrial siphon.

The division of the Polyclinidæ into genera is an exceedingly difficult matter. Previous to the publication of von Drasche's short note on *Polyclinoides diaphanum*, in 1883, the family seemed to fall naturally into two groups which have been recognised by most authors as the genera *Aplidium* and *Polyclinum*, but the subgenus *Polyclinoides*, proposed by von Drasche, unites the characters of *Aplidium* and *Polyclinum* in a way which renders it practically impossible to say to which group it really belongs. Von Drasche assigns it to *Aplidium*, but he might, I think, with equal propriety have placed it under the genus *Polyclinum*. Some of the new species described in the following pages also exhibit the same intermediate characters between the two groups, and render their recognition in the wider sense in which they are employed by Giard and von Drasche no

[1] Ueber die Knospung der Ascidien, *Archiv. f. mikrosk. Anat.*, Bd. x. p. 441, 1874.

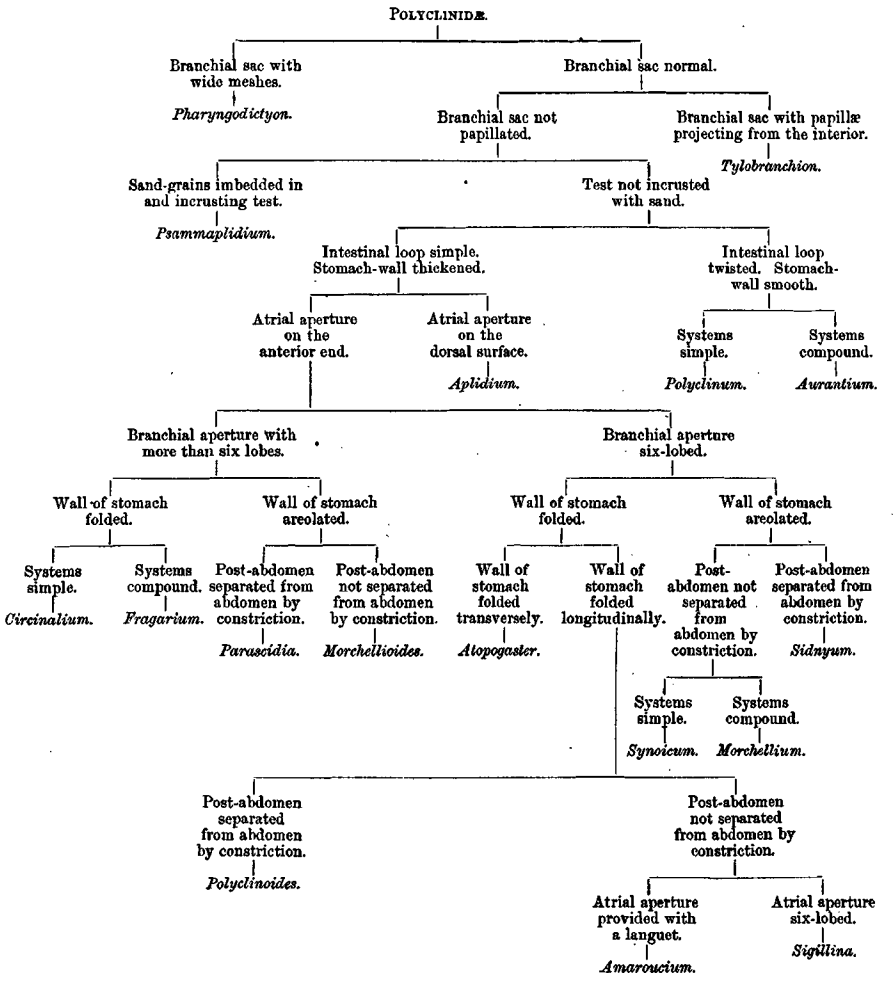
longer possible. Consequently, I feel compelled to arrange the large number of species composing the family in a series of closely allied groups which may be considered either as genera or as subgenera, and which are in some cases not very clearly separated from one another. The Polyclinidæ exhibit peculiarly well the difficulties in classifying which are the natural result of the origin of species by evolution: most of the groups pass gradually into one another, and strict lines of demarcation are almost always absent.

The subgenera proposed by Giard and by von Drasche have been retained, and along with the older genera of Savigny, Milne-Edwards, and others, and the new groups rendered necessary by some of the Challenger specimens, constitute the sets of species represented by the names in the Table below, and treated, for the sake of convenience, as genera in the following pages. In the Table (p. 152) the relative positions of the names do not always indicate the degree of affinity, and the distinguishing characters of the groups are stated in the briefest possible manner. The detailed characteristics and the genetic relationships are discussed under the head of each genus further on. I have avoided making use of the relative length of the post-abdomen as a distinguishing feature, as I am convinced that in some forms at least it is liable to very great variability, and even differs in size at different times in the life of the same Ascidiozooid.

Three of the groups in the Table—*Sigillina*, *Synoicum*, and *Sidnyum*—are Savigny's genera unchanged. Two of them—*Aplidium* and *Polyclinum*—are genera founded by Savigny, but now used in a more restricted sense. Four—*Aurantium*, *Circinalium*, *Fragarium*, and *Morchellium*—were subgenera proposed by Giard. *Amaroucium* and *Parascidia* were established by Milne-Edwards, and *Polyclinoides* by von Drasche; while the remaining five—*Pharyngodictyon*, *Tylobranchion*, *Atopogaster*, *Morchellioides*, and *Psammaplidium*—are new groups founded for the reception of Challenger species.

Pharyngodictyon is more clearly distinguished than any of the others, and is certainly worthy of distinct generic rank. In fact, it differs so markedly from all the other Polyclinidæ in the structure of the branchial sac, that possibly it might be placed in a distinct family by itself. In regard to the others, it must be left an open question whether they are genera or subgenera. They are all tolerably closely allied, and some species present intermediate characters between two or more of them, thus rendering precise definition exceedingly difficult, if not impossible. On the other hand, it would be very inconvenient to regard the whole family, with the exception of *Pharyngodictyon*, as constituting a single enormous genus. I believe it will be found useful to retain the divisions as genera, at least until a much more complete knowledge of the species from all parts of the world of this variable and apparently very large family of the Compound Ascidians permits of a new and more natural classification.

Circinalium, Giard, *Fragarium*, Giard, *Parascidia*, Milne-Edwards, *Synoicum*, Phipps, *Sigillina*, Savigny, and *Polyclinoides*, von Drasche, do not occur in the Challenger collection, but the other eleven genera of the family are all represented.



Pharyngodictyon,[1] n. gen.

Colony club-shaped, or consisting of a "head" placed on a short peduncle.
Systems inconspicuous.
Ascidiozooids very long antero-posteriorly, and distinctly divided into regions.
Test of a firm gelatinous consistence.

[1] From φάρυγξ and δίκτυον.

Branchial Sac formed of a simple meshwork of longitudinal and transverse vessels. No true stigmata present.

Dorsal Lamina represented by a series of languets.

Reproductive Organs placed in a long post-abdomen extending behind the intestinal loop.

This genus is formed for an interesting species obtained in the abyssal zone (1600 fathoms). In general appearance, and in the structure of most of the systems of the body, this form agrees with many of the other Polyclinidæ, but in the condition of the branchial sac it differs from all known species of Compound Ascidians, and exactly resembles the genera *Culeolus*, *Fungulus*, and *Bathyoncus* amongst Simple Ascidians. At first I felt inclined, on account of this great peculiarity, to regard this form as the type of a new family, but finally I decided to leave it as a very well marked genus of the Polyclinidæ. Further details and remarks are given under the specific description.

Pharyngodictyon mirabile, n. sp. (Pl. XXI. figs. 1–18).

The Colony consists of a more or less discoid mass, the "head," borne on a short peduncle. The upper surface of the head is usually flat, and nearly horizontal, while the lower tapers somewhat towards the top of the peduncle. The colony is attached by the base of the peduncle, which is considerably enlarged. The colour is light grey, with a slight yellowish tinge about the head. The surface is uneven and not very smooth. No common cloacal apertures are visible.

The length (from top of peduncle to upper surface of head) is 6 mm., and the breadth (greatest diameter of head) is 14 mm. The length of the peduncle is about 15 mm., and its thickness in the middle is 5 mm.

The Ascidiozooids are exceedingly long, and are placed nearly at right angles to the upper surface of the colony. Exclusive of the post-abdomen, containing the reproductive organs, the largest measure 4 mm. or 5 mm. antero-posteriorly. Beyond this the post-abdomen extends for fully as far again, and reaches into the peduncle. The anterior end of the Ascidiozooid is not wide, but a considerable part of the body is visible on the surface of the colony, forming a mark about 2 mm. in diameter.

The Test is moderately hard and firm. It is fairly transparent, and is of a greyish colour throughout. In sections the test is seen to consist of a perfectly structureless matrix, in which many small cells are imbedded. The cells are in some places very closely crowded. Most of them are round, but fusiform, triangular, and stellate forms also occur. They all have large nuclei, which stain very readily. No bladder cells are present.

The Mantle is moderately strong, and is provided with transverse equidistant muscle

bands of considerable size. Weaker longitudinal muscles are also present. The branchial sphincter is strong.

The Branchial Sac is long and rather narrow. It is very simple in its structure, consisting merely of transverse and longitudinal vessels intersecting at right angles, so as to form a large-meshed network. The meshes are a little longer vertically than transversely. The transverse and the longitudinal vessels are of the same size. They contain a few rather large muscle fibres.

The Tentacles are large. There are at least twelve, and they are all of much the same size.

The Dorsal Lamina is formed of a series of closely placed, irregularly triangular languets.

The Alimentary Canal is large.

The Reproductive Organs are large. They extend behind the intestine in the form of a long post-abdomen. Both ova and spermatic vesicles are present.

Locality.—Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom, Diatom ooze; bottom temperature, 34°·2 F.

This interesting form is one of the few deep-sea Compound Ascidians. It was trawled at Station 147, between the Cape of Good Hope and Kerguelen Island, from a depth of 1600 fathoms.

In its fungus-like form it resembles some of the species of *Colella*. The shape, however, varies considerably in the six specimens. One of the colonies was considerably damaged; a second is very small (Pl. XXI. fig. 3). The remaining four are of about the same size. In these the head is decidedly discoid in one specimen only (Pl. XXI. fig. 2). In two others it is flattish above and conical below. In the other colony it is in an intermediate condition. The three figures (Pl. XXI. figs. 1, 2, 3) show the amount of difference in the specimens. The upper surface of the head is irregular, being raised into slight elevations formed by the anterior ends of the Ascidiozooids. In some places the free edge of the disk is bent downwards so as to form a prominent ridge around the lower surface. The peduncle is thickest at the base of attachment, where it spreads out considerably. In one case this expanded base is over 13 mm. in diameter. Shells of Foraminifera and fragments of manganese are attached to and imbedded in the lower part of the peduncle. From the base the peduncle tapers upwards to its narrowest point just below the head, and then expands rapidly to pass into the under surface (see Pl. XXI. fig. 1).

The Ascidiozooids are very large; including the reproductive organs they measure in some cases as much as 13 mm. in antero-posterior extent (see Pl. XXI. figs. 4, 5). They are, however, rather narrow; the widest point is in the abdomen where the stomach is placed. The Ascidiozooids are not arranged with any regularity. They seem, however,

to be more numerous around the edges of the head, and the centre of the upper surface is more or less free from them. In one specimen there is an opening in the test at this point which is probably a common cloacal aperture. In two of the other colonies there is a distinct depression in the same region, and the surface of the test has a contracted appearance, so it is very probable that the centre of the upper surface is occupied by the common cloacal aperture, and that the Ascidiozooids are arranged more or less irregularly around this spot. The thorax of the Ascidiozooid is longer than the abdomen, but not so wide (see Pl. XXI. fig. 5), while the post-abdomen is longer than the thorax and the abdomen together.

The Ascidiozooids are of a pale opaque yellow colour, the test being grey and transparent. The test is very firm. Its surface glistens in parts but is not very smooth. Here and there a few grains of sand are found adhering. The test cells are very numerous in some places (Pl. XXI. fig. 6, *t.c.*). The matrix, although apparently structureless, seems to be denser in some places than in others, and in these regions stains more deeply with aniline blue and picrocarmine (Pl. XXI. fig. 7).

The musculature of the mantle is strong. The transverse bands are especially large (Pl. XXI. fig. 8), while the weaker longitudinal bundles are not confined to the branchial region but are continued down to the post-abdomen. The branchial siphon is of considerable size, and is cylindrical in shape (Pl. XXI. fig. 5). The sphincter occupies a large area. The mantle as a whole is very opaque, except over the reproductive organs in the post-abdomen. The muscle fibres are fusiform and not long (Pl. XXI. figs. 10, 11); they have large central nuclei surrounded by granular protoplasm (Pl. XXI. figs. 9, 10, 11). These simple muscle fibres are grouped in bundles in such a way that their large nuclei come more or less in line, and form conspicuous bands crossing the muscles transversely (Pl. XXI. figs. 8, 9).

The branchial sac is the most remarkable organ in this species. It is exceedingly simple (Pl. XXI. fig. 12), and has exactly the structure which is found in some of the deep-sea Simple Ascidians (*e.g.*, the genera *Culeolus* and *Fungulus* in the Bolteninæ and *Bathyoncus* in the Styelinæ[1]).

The sac consists merely of transverse and longitudinal vessels of much the same calibre (see Pl. XXI. fig. 12, *tr.*, and *i.l.*). The spaces between them cannot be called stigmata on account of their large size and their nearly square shape. Also, as in the corresponding forms of branchial sac in Simple Ascidians, no cilia are present, this being another reason why the spaces should not be considered as stigmata. And yet if they are not stigmata the longitudinal vessels cannot correspond to the fine interstigmatic vessels of other forms, and must be regarded as internal longitudinal bars, which the similar vessels in *Culeolus* probably are. I prefer this alternative, although it necessitates the separation of this form from the other Polyclinidæ, none of which have

[1] See Part I. of this Report (in vol. vi., 1882, pp. 90, 122, 127, and 165).

internal longitudinal bars in the branchial sac. No calcareous spicules like those of *Culeolus* are present in the vessels of *Pharyngodictyon*, but a few rather large muscle fibres are found traversing them. The walls of the vessels are covered with squamous epithelium except on the internal edges of the longitudinal bars, where the cells become columnar and have tapering pointed free ends (Pl. XXI. fig. 13).

The endostyle is large and conspicuous. In side view (Pl. XXI. fig. 5) its course is nearly straight, but when seen in front view (Pl. XXI. fig. 16) the edges are found to be very much undulated. The very considerable breadth of the organ is also seen in this view.

The tentacles are large and fairly numerous. They are wide at their bases and recall by their appearance (Pl. XXI. fig. 14) the tentacles of some species of *Styela* amongst the Simple Ascidians. The upper surface of the tentacle is covered by a broad band of cubical epithelium (Pl. XXI. figs. 14, 15), while the sides and lower surface are formed of squamous cells. The usual septum of connective tissue is present in the interior (Pl. XXI. fig. 15).

The alimentary canal forms a large mass (Pl. XXI. fig. 5), including the widest portion of the body; it is very opaque. The stomach is a large ovate, thick-walled organ on the dorsal edge. It has ridges projecting into the interior. The intestine extends posteriorly for a short distance and then turns sharply to the ventral side and anteriorly. It is a large tube irregularly swollen with fæces at intervals. It forms the ventral edge of the visceral mass, and then crosses the œsophagus to reach the dorsal side of the branchial sac (Pl. XXI. fig. 5). In sections the stomach and intestine are found to contain great masses of a soft greyish colour composed mainly of Diatoms.[1]

The mature Ascidiozooids are hermaphrodite. The large genital organs lie completely posterior to the alimentary canal in a long diverticulum of the mantle, which is the post-abdomen. The anterior portion of the post-abdomen (Pl. XXI. fig. 5) is narrow and contains the genital ducts. Further back it swells into a fusiform body, in which the ova and the spermatic vesicles lie, and behind this it is continued into a long narrow tail which usually terminates in a slightly swollen extremity (Pl. XXI. fig. 5). One or two large yellow ova usually occupy the centre of the fusiform genital mass, while in front and behind are placed the small ovate or globular spermatic vesicles. The latter are usually about twelve or fifteen in number, and they stain a very deep red with picrocarmine. Each has a fine duct which runs upwards to join the vas deferens (Pl. XXI. fig. 17). This tube is large and conspicuous. It is formed at the upper end of the genital mass by the junction of the ducts from the spermatic vesicles (Pl. XXI. fig. 5), and runs forwards over the alimentary viscera to reach the rectum, up which it courses to its termination in the dorsal part of the peribranchial cavity. The upper part of the vas deferens is usually a little wider than the rest. The ova are of very

[1] The deposit on the bottom at Station 147, where this species was obtained, is Diatom ooze.

large size (Pl. XXI. fig. 5) and are usually rather opaque. In some sections of the genital mass their germinal vesicles and germinal spots are remarkably well seen, and a distinct dot inside the germinal spot is visible. Transverse sections through the post-abdomen behind the genital mass show that it is traversed by the usual double-walled thin septum, which is curved so that its lumen is sigmoid (Pl. XXI. fig. 18). The remainder of the post-abdomen is almost entirely formed of opaque mesoderm cells. Figure 18 represents an oblique section, and the three cavities at its upper end are spaces which were occupied by the spermatic vesicles forming the lower part of the genital mass.

Tylobranchion,[1] n. gen.

Colony large and massive.
Systems inconspicuous.
Ascidiozooids large, elongated antero-posteriorly, and distinctly divided into regions.
Test gelatinous.
Branchial Sac large and well developed. Transverse vessels provided with numerous large papillæ.
Dorsal Lamina represented by a series of languets.
Alimentary Canal large. Stomach-wall folded longitudinally.
Reproductive Organs forming a long post-abdomen.

This genus is distinguished from the other Polyclinidæ by the structure of the branchial sac. This organ is large and well developed, and it possesses numerous stigmata which vary considerably in size, but the most important point is that the transverse vessels, which are numerous and of large size, bear on their inner edges well-marked papillæ projecting into the cavity of the sac. These papillæ probably represent the connecting ducts of the Simple Ascidians, and if we regard the longitudinal vessels in the branchial sac of *Pharyngodictyon mirabile* as being internal longitudinal bars, then the present genus will occupy an intermediate position between that form and the other Polyclinidæ as regards the development of this part of the branchial sac. Further remarks will be found under the description of the single species.

Tylobranchion speciosum, n. sp. (Pl. XXII. figs. 1–17).

The Colony is irregularly wedge-shaped, with the larger end uppermost. The base of attachment at the posterior end is comparatively small, and from this point the colony

[1] From τύλος and βράγχιον.

increases in size towards the top, which is large and irregularly convex. The posterior half or two-thirds forms a short stout peduncle. The colour varies from dark grey near the point of attachment to light yellowish-grey at the upper end. The surface is very uneven, but is smooth and glistening.

The length is about 8 cm., the greatest breadth is 5·5 cm., and the greatest thickness is 2·5 cm.

The Ascidiozooids are very large (up to 2 cm. in antero-posterior extent, and about 2·5 mm. at the widest point). The body is divided into three distinct regions; the thorax is about 4 mm. in length, the abdomen 3 mm., and the post-abdomen from 2 mm. to 14 mm. in length. The branchial and the atrial apertures are both six-lobed. The Ascidiozooids are placed vertically in the colony, with their anterior ends on the convex upper surface; there is no arrangement in systems, and no common cloacal apertures are present.

The Test is firm and cartilaginous in the lower part of the colony, but soft and gelatinous in the upper part. It is semi-transparent and of a grey colour throughout, varying from a dark bluish-grey at the posterior end to a light yellowish-grey on the upper surface. The matrix of the test is crowded with minute cells of various shapes; no bladder cells or pigment cells are present. There are very few vessels in the test.

The Mantle is strong, and has a well-developed musculature. The muscle bands on the branchial region are very thick, and they branch to form an irregular network. Over the long genital region of the body the mantle contains a number of closely placed longitudinally running bundles of muscle fibres. These are narrow, and do not branch. In the intestinal region the mantle is thin, with little or no musculature.

The Branchial Sac is large, and contains a great number of stigmata, which vary in size from small round openings to very long narrow slits. The transverse vessels differ greatly in their breadth. Where they lie between rows of small stigmata they are very broad, but where the stigmata in the adjacent rows are long, the transverse vessels are considerably reduced in size. There are no horizontal membranes, but the transverse vessels bear rows of irregularly shaped papillæ projecting into the interior of the sac, and usually having their free ends more or less lobed. As a rule, these papillæ are largest where the neighbouring stigmata are small.

The Endostyle is large and conspicuous. It has a very undulating course.

The Dorsal Lamina is formed of a large number of closely placed languets.

The Tentacles are numerous and of different lengths, but are not arranged with any regularity.

The Dorsal Tubercle is in the form of an ovate slit of considerable size, surrounded by broad raised margins.

The Alimentary Canal is large, and is of an opaque greyish-yellow colour. The stomach is large, and its wall is longitudinally folded. The rectum is very wide.

The Reproductive Organs are placed behind the intestinal loop, and may extend posteriorly for a great distance. They are usually over 1 cm. in length.

Locality.—(*a*) Kerguelen Island, 10 to 60 fathoms; one large and one small colony. (*b*) Kerguelen Island, 10 to 100 fathoms; one small colony.

Three specimens of this remarkable species were obtained at Kerguelen Island, at depths between 10 and 100 fathoms. One of them is a large colony (Pl. XXII. fig. 1), from which the description and measurements given above are taken, the other two are very much smaller.

The large colony has been evidently flattened somewhat during preservation; the natural thickness was therefore probably greater than what is stated above. The upper part is formed of two masses, each with a separate short peduncle, which join about one-third of the way down. One of the "heads" is considerably larger than the other, but in all other particulars they agree closely. The posterior part of the colony forming the common peduncle is about 3 cm. in its greatest thickness. It is formed of dark grey test, with a slight slate-blue tinge. This region expands rapidly above to form the convex upper part of the colony in which the Ascidiozooids are imbedded (Pl. XXII. fig. 1). Here the colour is lighter and has a yellowish tint, and the test is much softer and more yielding than lower down. The outer layer of test over the whole colony is very smooth and glistening, but it does not form a firmer or harder layer which may be stripped off as in the case of some other Compound Ascidians. The bodies of the Ascidiozooids show through the test of the upper part of the colony as long, opaque, yellow bands, becoming indistinct at their lower ends, where they are not so opaque, and the surrounding test is less transparent (Pl. XXII. fig. 1).

The Ascidiozooids are not arranged with any regularity, but occur at fairly equal distances all through the test in the upper part of the colony. Their anterior ends in many cases form small papillæ, while in other cases the Ascidiozooids have contracted away from the superficial layer of test, and occupy depressions.

The two smaller colonies are nearly of the same size, the one being 2·5 cm. long and 1 cm. broad at the top, and the other 3·5 cm. long and about 1·5 cm. broad. The general shape of body is much the same as in the large colony. The specimen from "Kerguelen, 10 to 100 fathoms"—the smallest colony—is less wedge-shaped than the others, and would be more properly described as irregularly club-shaped. The peduncle is narrow, and the upper part occupied by the Ascidiozooids is rounded, there being no lateral compression.

The Ascidiozooids in all three colonies are very large. They vary from 1 cm. to 2 cm. in antero-posterior length (Pl. XXII. figs. 2, 3), and are generally about 2 mm. across at the widest part, which is near the anterior end. The three regions of which the body is formed correspond to Milne-Edwards' "thorax," "abdomen," and "post-

abdomen," and the great difference in length between different Ascidiozooids is mainly due to variations in the size of the post-abdomen or genital region. In some it is very small, being merely a short conical projection extending scarcely 2 mm. behind the intestinal loop (Pl. XXII. fig. 2), while in others (most of the Ascidiozooids) it forms a very long appendage, which may be twice as long as the rest of the body, though not so wide (Pl. XXII. fig. 3).

The test is exceedingly full of small test cells, exhibiting the usual variety in shape. Most of them are round, or nearly so, elongated and branched forms being less common (Pl. XXII. fig. 5). There are apparently no bladder cells even in the outer layer of the upper part of the colony, a region where they are generally seen. Delicate vascular appendages extend from the posterior extremities of the Ascidiozooids (Pl. XXII. fig. 4) downwards through the lower part of the colony. Some of them are just visible to the eye as fine lines in the dark grey test forming the peduncle.

In all the colonies there is a distinct line in the test marking the point where the upper soft convex mass, containing the branchial and intestinal parts of the Ascidiozooids (Pl. XXII. fig. 1), joins the peduncle, in which the genital regions and the vascular appendages are placed. Above this line the test is distinctly more of a yellowish tint than below it.

The ectoderm is very distinct, and can be separated as a coherent membrane from the test and the mantle. The mantle is very muscular, especially over the branchial region of the body, where the musculature is more like that of an *Ascidia* or a *Corella* than of a Compound Ascidian (see Pl. XXII. fig. 4).

Over the intestinal part of the body the muscles are not entirely absent, but they are much more feebly developed, and consist of fine bands running mainly in a longitudinal direction and occasionally branching and interlacing (Pl. XXII. fig. 4). On the post-abdomen or genital region the musculature is rather stronger, and is composed of a large number of longitudinal bands running nearly parallel to one another and forming a well-marked muscular investment to the reproductive organs. The branchial and atrial apertures are each provided with six well-marked lobes (Pl. XXII. fig. 4), and the sphincters are well developed.

The branchial sac is the most characteristic and remarkable organ of this species. It is very large, and has an enormous number of stigmata for a Compound Ascidian. These stigmata vary greatly in size, some rows being exceedingly small circular openings (Pl. XXII. fig. 8, *sg.*), while others are long narrow slits like the stigmata of a Simple Ascidian (Pl. XXII. fig. 9, *sg.*). In the small stigmata the ciliated stigmatic cells are small and rounded (Pl. XXII. fig. 10, *sg.*), while in the long narrow stigmata the cells are well defined with triangular projecting free ends (Pl. XXII. fig. 11). There are connectives running between the transverse vessels and the sinuses in the mantle outside.

The transverse vessels, which vary greatly in size, being in some places several times

as wide as the length of the adjacent stigmata, are produced inwards to form series of hollow papillæ of various sizes and shapes. These papillæ are arranged with a certain amount of regularity. They form a single row only on each transverse vessel, and they are placed at equidistant points, but they are much more developed in some parts of the sac than in others, while in some regions they are altogether absent (Pl. XXII. fig. 8). Where they are large their free ends show a tendency to split into two or three branches (Pl. XXII. figs. 7, 10, *p.*), and this as well as their equidistant arrangement gives them very much the appearance of the connecting ducts and rudimentary internal longitudinal bars often seen on the transverse vessels of some Simple Ascidians (*e.g.*, *Corella parallelogramma*, *Corella japonica*, and *Ascidia triangularis*[1]). In some parts of the sac where the papillæ are rather wide, flattened, and triangular in shape, with the ends unbranched, they resemble the large triangular connecting ducts of some Clavelinidæ (*Ecteinascidia crassa* and *Ecteinascidia fusca*),[2] and I think there can be no doubt that they really are connecting ducts in a rudimentary condition. The only question is whether this species should be regarded as a form in which internal longitudinal bars are beginning to develop, or one in which, as the result of degeneration, these structures have been lost, with the exception of the papillæ representing the rudimentary connecting ducts. The answer to this question involves a discussion of the probable phylogeny of the Compound Ascidians, and may therefore be deferred to the general summary at the conclusion of this Report.

The languets representing the dorsal lamina are long and narrow, and are not flattened antero-posteriorly. They have much more of the shape of a tentacle than is usual, and closely resemble the languets of *Ecteinascidia turbinata*[3] amongst Simple Ascidians. They obviously correspond to the papillæ on the transverse vessels with which they are in series (Pl. XXII. fig. 12, *l.*), and from which they only differ in size. This adds to the arguments which I have already brought forward[4] in favour of the languets being homologous with the connecting ducts, and not with the papillæ which project from the internal longitudinal bars in many Simple Ascidians.

The tentacles are numerous and closely placed (Pl. XXII. fig. 13, *tr.*). Most of them are long. Some are shorter, but they do not occur in any definite order. The endostyle undulates considerably from side to side (Pl. XXII. fig. 6).

The peripharyngeal band is well marked (Pl. XXII. fig. 13, *p.p.*). It curves posteriorly in the dorsal region to form a moderately deep peritubercular area in which the large but simple dorsal tubercle lies. The opening of this organ is a narrow ovate slit, with the wider end posterior (Pl. XXII. fig. 13, *d.t.*). The margin is broad and conspicuous. The tubercle touches the peripharyngeal band with its posterior

[1] See Herdman, part i. of this Report (vol. vi. 1882), p. 192, pl. xxvi. fig. 8; and Notes on British Tunicata, *Journ. Linn. Soc. Zool.*, vol. xv. p. 283, 1880.

[2] Part i. of this Report (vol. vi. 1882), pp. 240, 242, pl. xxxvi. figs. 8, 13, 14.

[3] *Loc. cit.*, p. 243, pl. xxxvi. fig. 6.

[4] *Loc. cit.*, p. 284.

edge, leaving a wide prebranchial zone between its anterior end and the bases of the tentacles.

The œsophagus commences at the posterior end of the dorsal edge of the branchial sac and runs directly backwards (Pl. XXII. fig. 4). It is a long and narrow tube with moderately thick walls slightly corrugated in parts. The stomach is a large ovate organ with its long axis placed antero-posteriorly, and with the narrower end forwards. The walls, which are only moderately thick, are folded longitudinally (Pl. XXII. fig. 4). The intestine, after leaving the posterior end of the stomach, from which it is separated by a marked constriction, runs for a short distance backwards, and then turns round dorsally and anteriorly to continue its course forwards, as the rectum, lying at first alongside the stomach and œsophagus, and then running up the dorsal edge of the branchial sac to the anus, which is placed far forwards in the peribranchial chamber close to the atrial aperture. The intestine where it leaves the stomach is rather thick-walled and narrow, not much wider than the œsophagus, but while curving round at the posterior end it becomes rapidly wider and its wall is greatly reduced in thickness. The rectum is nearly as wide as the stomach (Pl. XXII. fig. 4), and its wall is so thin as to be almost transparent. The fæces are of a brownish colour, and are composed mainly of Diatoms.

The reproductive organs forming the post-abdomen vary greatly in size, but in nearly all the Ascidiozooids examined they consist merely of spermatic vesicles and their ducts. Large ova, of an opaque orange colour, and embryos in various stages of development are common, however, in the peribranchial cavity, which is in some cases greatly distended with them. Possibly the ova are only produced at a certain season of the year, but I think it much more probable that they are formed at a certain period in the life of the Ascidiozooid. Ova in various stages were found in one or two of the younger and smaller Ascidiozooids, but certainly all the large specimens which I examined were male. Probably the ova are formed first, and pass up into the peribranchial cavity when the testes begin to develop.

Figure 14 in Plate XXII. represents a diagrammatic transverse section through the post-abdomen of a young Ascidiozooid. It is formed of an outer coating of ectoderm (*ec.*), inside which is a layer of connective tissue with muscle bands (*m.b.*). This is the mantle, and it encloses a mass of mesoderm tissue traversed by branching tubes (*g.t.*) containing germinal cells. Around these reproductive tubes are blood-sinuses (*b.s*) containing blood-corpuscles. Figures 15 and 16 show a small part of a section of a young post-abdomen where the germinal cells are seen in various stages of development into ova. Figure 17 gives a similar view of part of the post-abdomen of a larger and older Ascidiozooid, where the reproductive tubes have their branches much dilated at the ends to form spherical or ovate bulbs more or less filled with developing spermatozoa. The mantle and the blood-sinuses remain unchanged. Evidently the young

Ascidiozooid is female and the older one male, and the ova and spermatozoa develop from mesodermal cells in the same reproductive tubules, which, however, become more numerous and change their shape somewhat when being converted into spermatic vesicles. The vas deferens is very long and convoluted, and is conspicuous from near the top of the post-abdomen onwards. It adheres to the rectum along its entire length, and terminates a short distance in front of the anus.

This species is particularly interesting on account of the resemblances it shows to some of the Ascidiæ Simplices. From its general anatomy, and especially from the relations of the intestine to the branchial sac and the reproductive organs, it is clearly a member of the family Polyclinidæ, but the musculature of the mantle is quite unlike that of most Compound Ascidians. The muscle bands in the thoracic region, while branching and anastomosing irregularly, have their main lines more or less antero-posterior (Pl. XXII. fig. 4), while the general rule amongst Compound Ascidians is that the chief muscle bands should run transversely. Then the branchial sac shows resemblances to the Clavelinidæ in the large number of stigmata, in the presence of the rudimentary connecting ducts on the transverse vessels, and in the long, narrow languets. Lastly, the tentacles are numerous and closely placed at their bases (Pl. XXII. fig. 13), just as in many Ascidiæ Simplices, while in Compound Ascidians, as a rule, the tentacles are few in number (usually eight or sixteen), and are arranged regularly at equal distances apart.

Atopogaster,[1] n. gen.

Colony massive, and usually of large size.
Systems simple or inconspicuous.
Ascidiozooids large or small, always much elongated antero-posteriorly. Branchial aperture six-lobed.
Test thick, and usually cartilaginous and tough; not incrusted with sand.
Branchial Sac usually well developed.
Alimentary Canal large. Stomach-wall folded transversely.
Post-Abdomen long.

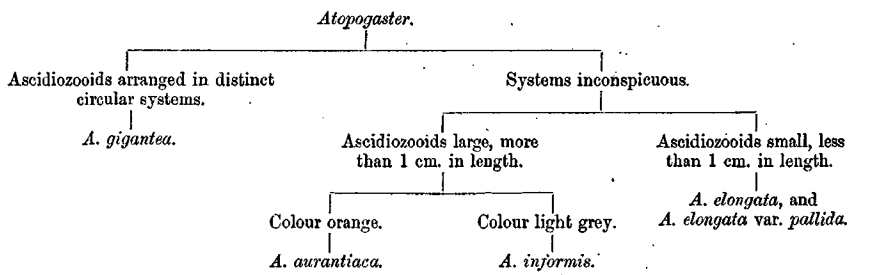
I have separated this little group of species from the other Polyclinidæ on account of their possessing a large stomach, the wall of which is thrown into transverse folds. It is very convenient to make use of the characters of the stomach-wall in dividing up this family into sections, a course pursued first by Giard; but I am doubtful whether the groups so produced are in all cases natural. In the present genus the mere presence of folds distinguishes from *Synoicum*, *Morchellium*, *Morchellioides*, and *Sidnyum*, while

[1] From ἄτοπος and γαστήρ.

their transverse direction separates the group from *Polyclinoides*, *Amaroucium*, and *Sigillina* (see Table, p. 152); but in general appearance, and especially in size of Ascidiozooid, *Atopogaster aurantiaca* and *Atopogaster elongata* differ so remarkably that I am inclined to think that they ought to belong to distinct sections of the family. Then in some respects *Atopogaster aurantiaca* appears to be allied to *Tylobranchion speciosum*, from which, however, it differs totally in the condition of the branchial sac. *Atopogaster gigantea*, again, differs from the other members of the genus in the simple and conspicuous systems formed by the Ascidiozooids (see Pl. XXIII. fig. 2), and in this respect approaches some species of *Polyclinum* (see *Polyclinum pyriformis*). The relationships of the different Polyclinidæ are very complicated. They seem to form an irregular network, and it is very difficult to determine which characters indicate most clearly the genetic affinity.

In all the species of this genus, however, the colony is massive, the amount of test present is large, and it is tough and cartilaginous in its nature; the Ascidiozooids are greatly elongated antero-posteriorly, and the post-abdomen is large; and lastly, in all, the stomach is more or less distinctly folded in a transverse direction.

The species may be distinguished by means of the following table :—



This arrangement divides the genus into three sections which seem to be natural:— (1) With distinct systems, *Atopogaster gigantea*; (2) with very large Ascidiozooids, *Atopogaster aurantiaca* and *Atopogaster informis*; and (3) with small Ascidiozooids, *Atopogaster elongata*, and *Atopogaster elongata* var. *pallida*.

Atopogaster gigantea, n. sp. (Pl. XXIII. figs. 1–6).

The Colony is a very large mass of elongated form attached by the posterior end, and extending upwards with a slight curve to a considerable height. It narrows gradually above the middle, and the upper end is obtusely pointed. The colony is slightly compressed laterally. The colour is an opaque whitish-grey with a slight hyaline tinge in places. The surface is somewhat uneven, and is slightly rough all over.

The length of the colony is 26 cm., the greatest breadth is 7·5 cm., and the average thickness is 4 cm.

The Ascidiozooids are very long and narrow, and are placed more or less vertically in the test. They are arranged in circular systems, consisting each of from six to twelve Ascidiozooids arranged around a centrally placed common cloaca. The body is usually over 1 cm. in length, and consists of three well-defined regions. The thorax is about 2 mm. in antero-posterior length, and rather more than 1 mm. in breadth (dorso-ventrally). The abdomen is narrower, and is usually 3 or 4 mm. in length, while the post-abdomen may be short—a few millimetres—but more usually extends as a narrow undulating thread for a considerable distance downwards into the colony.

The Test is firm and cartilaginous but not hard. It is of a light grey colour, and is semi-transparent. The matrix is clear and homogeneous, and the small test cells are numerous. There are no bladder cells.

The Mantle is not strong. The muscle bands run mainly in a longitudinal direction. They are narrow and not very numerous.

The Branchial Sac is fairly large. The transverse vessels are wide, and are supplied with muscle fibres. The stigmata are wider than the fine longitudinal vessels, and are arranged with regularity.

The Dorsal Lamina is represented by a series of pointed languets.

The Tentacles are rather small, and they are not numerous.

The Dorsal Tubercle has a small round aperture.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

This is the largest Compound Ascidian in the Challenger collection, and, like so many other large Tunicata (*e.g.*, *Molgula gigantea* and *Goodsiria coccinea*), was obtained in the Strait of Magellan. The colony is an elongated mass (Pl. XXIII. fig. 1[1]), and was evidently attached by one end, upon which it stood upright in the water. The lower end has small stones, sand-grains, &c., imbedded in it for a distance of from 1 cm. to 3 cm., and some colonies of Hydroid Zoophytes are attached to this region. The widest point is about half way up, and from this region it tapers slightly both upwards and downwards equally till it reaches about 3 cm. from the top or the base. At these points the width is about 5 cm. The upper end has a rounded point. The colour is fairly uniform all over. The few places where a slight hyaline tint is seen are regions where there are no Ascidiozooids, and where therefore test alone is seen. The general roughness of the surface is caused in great part by the anterior ends of the Ascidiozooids usually projecting slightly beyond the level of the test, but besides this there are slight grooves and ridges, due possibly to the contraction of the test on being placed in alcohol.

[1] This figure represents the colony reduced to one half of the natural size.

The Ascidiozooids, of which there are probably ten or twelve thousand, are arranged in systems which are clearly visible on the outside of the colony, on account of the test being decidedly more transparent than the whitish-grey bodies of the Ascidiozooids. The systems are mostly circular in outline (Pl. XXIII. fig. 2), like those of the genus *Botryllus*, but in some cases they are elliptical, ovate, crescentic, or more irregular; they never form branched lines as in *Botrylloides*. Each system has a centrally placed common cloaca, usually of large size and distinctly visible. Many of these cavities are occupied by Copepoda, and the legs of the Crustaceans may usually be seen projecting from the openings. The systems are closely placed, and are nearly equally numerous over all parts of the colony. An average sized system has nine or ten Ascidiozooids, and is about 5 mm. in diameter.

The Ascidiozooids, although small relatively to the size of the colony, are of considerable length. The anterior end, which is visible on the outside, is only about 0·5 mm. in diameter. The middle of the thorax is the widest region, while the abdomen and post-abdomen are both narrow, especially the latter (Pl. XXIII. fig. 3). The widest part of the abdomen is about its middle, as it is connected with the thorax by a narrower region anteriorly, and tapers posteriorly to join the genital region. The post-abdomen is usually very long and narrow, and the test in all parts of the colony is found to be penetrated by the delicate thread-like posterior ends of the bodies of the Ascidiozooids. Even the very centre of the colony at the widest part, where it is at least 2 or 3 cm. from the surface, is traversed in all directions by these threads. They are, like the rest of the body, of an opaque pale yellowish-white colour, and have an irregularly undulating course. The anterior part of the Ascidiozooid is placed approximately at right angles to the outer surface, but the posterior part becomes bent so as to run downwards towards the base of the colony.

The test is a solid firm mass but it is not hard, and is transparent in small pieces. The small test cells are very numerous and are of all shapes; some very beautifully branched forms occur. The test is slightly softer and less dense, and contains more cells, in a layer immediately surrounding the bodies of the Ascidiozooids. This is seen very clearly in sections stained with aniline blue, where this layer takes on the stain a little differently from the remainder of the test, and is thus rendered conspicuous. Many of the cells are very granular, but there are no opaque pigment-corpuscles present. The cells are particularly granular near the edges of the colony, where the test is growing most rapidly, and they are arranged more or less regularly in rows running parallel with the outer surface.

The mantle varies considerably in the different regions of the body. Over the branchial sac the muscle bands are rather distant. Some transverse muscles are present, but the longitudinal bands are the most important. Over the abdominal viscera there are no transverse muscles, and the longitudinal ones are few and slight, but on the post-

abdomen the longitudinal bands become more numerous and form a strong muscular investment to the reproductive organs. The branchial siphon is rather long (Pl. XXIII. figs. 3, 5), and its anterior end is distinctly six-lobed. In some cases the lobes are large and widely separated (Pl. XXIII. fig. 5). The sphincter is well developed.

The branchial sac is rather long and narrow, and contains many rows of stigmata. The most noteworthy feature in regard to it is the comparatively great width of the transverse vessels, which are all of the same size, and have bands of muscle fibres running along their length (Pl. XXIII. fig. 4, *m.f.*). In some specimens neither the transverse vessels nor the stigmata are quite so wide as the figure shows. The ciliated cells placed along the sides of the stigmata are large and distinct, and have their free ends pointed.

The endostyle is narrow and inconspicuous, its course is undulating. The languets are not numerous, but they are rather large; they are tentacular in form and are pointed. The tentacles are rather inconspicuous, and the aperture of the dorsal tubercle is very small. The nerve-ganglion is large and globular.

The alimentary canal forms a long narrow loop (Pl. XXIII. fig. 3). The œsophagus commences at the posterior end of the dorsal edge of the branchial sac, and runs directly backwards. It is funnel-shaped at its upper end (Pl. XXIII. fig. 3, *œ.*), and then rapidly narrows to form a slender tube which opens into the anterior extremity of the somewhat ovate stomach. The long axis of the stomach is directed antero-posteriorly, and the anterior end is the wider and more rounded of the two. The wall of the stomach is usually somewhat folded transversely. The intestine emerges from the narrow posterior end of the stomach, and runs backwards as a tube of variable calibre and irregular course (Pl. XXIII. fig. 3, *i.*). It then turns round ventrally and anteriorly, and becoming suddenly wider runs forwards as the rectum parallel to the intestine, stomach, and œsophagus to reach the posterior end of the branchial sac, where it crosses over to the dorsal side, and finally opens into the peribranchial cavity.

The reproductive organs lie completely behind the intestinal loop. Both ova and spermatic vesicles may be found in the same Ascidiozooid. The vas deferens is a long tube, but it is not so conspicuous as is usual in the Compound Ascidians. Tailed larvæ were found in some Ascidiozooids lying in considerable numbers in the peribranchial cavities. They have long narrow bodies (Pl. XXIII. fig. 6) provided anteriorly with three slender adhering papillæ, and the pigmented sense-organs (of which two are present) are placed close together near the posterior end of the body.

In several of the Ascidiozooids ova of smaller size than those in the post-abdomen and small embryos in various stages of development were found in the dorsal part of the peribranchial cavity. A careful examination showed that these were Crustacean embryos, and a few completely developed Nauplii were found amongst them. They evidently belong to the Copepoda living in the common cloacal cavities of the colony, and as the

peribranchial cavity communicates directly with the common cloacal cavity through the atrial aperture, it is easy to understand how the Copepod might pass its ova into the peribranchial cavities of adjoining Ascidiozooids and use them as incubatory pouches. In one or two cases the larval Ascidians and the larval Crustaceans were found developing side by side in the same peribranchial cavity.

Atopogaster aurantiaca, n. sp. (Pl. XXIII. figs. 7–13).

The Colony is irregularly wedge-shaped, with the larger end uppermost. The point of attachment, which is placed at the posterior end, is comparatively small, and the colony increases rapidly in size towards the top, which is very large and irregularly convex. The posterior two-thirds of the colony forms a short and very stout peduncle. The colour is orange, having in some places a greyish tint and in other places becoming reddish-brown. The surface is uneven but smooth.

The length is about 7 cm., the greatest breadth is 6·5 cm., and the greatest thickness 4·5 cm.

The Ascidiozooids are very long (up to about 3 cm. in antero-posterior extent, and about 2·5 mm. at the widest point). The body is divided into three regions, of which the abdomen or intestinal part is very much the largest, being more than twice as long as the other two regions together. The Ascidiozooids are placed more or less vertically in the colony, with their anterior ends on the large upper surface; there is no arrangement in systems, and no common cloacal apertures are present.

The Test is firm and cartilaginous all over, but is particularly hard in the lower part of the colony. It is semi-transparent and is of a yellowish or orange-grey colour throughout. It is darker towards the posterior end and lighter on the upper surface. The matrix of the test contains many small cells of various shapes, in some places closely crowded together. There are very few vessels and bladder cells in the test.

The Mantle is moderately thick, and is nearly equally muscular all over the anterior half of the body. The muscle bands are fine but very numerous, and they nearly all run longitudinally. The sphincters are well developed, and both apertures are deeply six-lobed.

The Branchial Sac is of moderate size and has many stigmata placed in about twenty regular rows. The transverse vessels are all of the same size, and bear short horizontal membranes which project inwards. The stigmata are all of much the same size, and are arranged with regularity. They are of moderate length, and the ciliated cells are large and pointed at their free ends.

The Endostyle is large and conspicuous, its course is very undulating.

The Dorsal Lamina is formed of a large number of long narrow pointed languets.

The Tentacles are large and fairly numerous; they are not all of one length.

The Dorsal Tubercle is placed far forward near to the base of the tentacles. It is inconspicuous and has a simple opening.

The Alimentary Canal is remarkable on account of its very great length. The stomach is elongated and is folded transversely, and the intestine is exceedingly long.

The Reproductive Organs are placed at the posterior end of the body and extend for a variable distance beyond the intestinal loop. They are hermaphrodite.

Locality.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells.

This species is founded for a single large colony obtained in Bass' Strait, between Australia and Moncœur Island, from a depth of 38 to 40 fathoms. It seems to be allied in some respects to the previously described *Tylobranchion speciosum*, but differs from it in many points, both of external appearance and internal structure, which are discussed below.

The colony is short and broad, and is wedge-shaped as seen in lateral view (Pl. XXIII. fig. 7). The base of attachment is much smaller than in the last species, being only about 2 cm. in diameter. The upper surface seems to have been unnaturally flattened during preservation. Probably when living it was slightly convex all over. The peduncle is 5·5 cm. in thickness at its upper end, and there is a distinct line where it joins the upper softer region of the colony.

The general colour is orange. On the peduncle it is tinged with grey, while in some parts of the upper surface it becomes a reddish-brown or burnt sienna. The outer layer of test over the whole colony is very smooth. The surface is much more even on the peduncle than elsewhere.

The bodies of the Ascidiozooids show through very slightly as the test is not nearly so transparent as in the case of *Tylobranchion speciosum*. The Ascidiozooids are not arranged with any regularity; their anterior ends occupy depressions in the surface layer of the test. They are probably larger than the Ascidiozooids of any other known Compound Ascidian. In one measuring 2·5 cm. in antero-posterior extent, the thorax is 7 mm. in length, the abdomen 15 mm., and the genital part or post-abdomen 3 mm. In some Ascidiozooids the genital region is much larger.

The apertures are very closely placed at the anterior end of the body, and in the greater part of its length the Ascidiozooid is relatively very narrow. The widest region is towards the posterior end of the abdomen, the thorax being unusually narrow. A branchial region 7 mm. in length is only 1·5 mm. wide.

The test is very much harder than in the case of *Tylobranchion speciosum*, but, like it, is rather softer on the upper surface than elsewhere. The yellow or light colour of the test is much more marked in the outer part than in the deeper layers, where it is grey with a slight yellowish tinge. The test cells are numerous and of rather large

size (Pl. XXIII. fig. 9, *t.c.*). They exhibit the usual variety of shape and have a granular appearance. Pigmented cells are fairly numerous. In some places they are scattered singly and have a rounded form. In others they are aggregated to form small clumps in which the individual cells are more or less polygonal from mutual pressure (Pl. XXIII. fig. 9, *p.c.*). These pigmented cells are of a light-yellow colour in thin unstained sections. They stain readily with picrocarmine, aniline blue, and other dyes. There are a few bladder cells in the outer layers of the test but none in the deeper parts. The vessels are narrow, not at all numerous, and end in elongated bulbs (Pl. XXIII. fig. 9, *t.k.*). The matrix as a rule is homogeneous in appearance, but in some places it is very slightly fibrillated. The ectoderm is very well marked, and can be separated from both test and mantle, between which it lies, as a distinct membrane.

The mantle is remarkable on account of the longitudinal arrangement of nearly all the muscle bands. They are very delicate but fairly numerous, and are arranged with great regularity. They form a moderately strong musculature on the branchial region of the body, which becomes much less powerful as it is traced posteriorly over the viscera. On the lower part of the abdomen and on the post-abdomen the muscle bands are few and very narrow. The sphincters around the apertures are fairly well developed. The mantle is deeply cleft, at both branchial and atrial apertures, into six regularly shaped and equal lobes (Pl. XXIII. fig. 8).

The transverse vessels of the branchial sac are wide and have well-marked horizontal membranes, but no papillæ or other projections are present. The stigmata are much more regularly placed than in *Tylobranchion speciosum*, and are of a fair size (Pl. XXIII. fig. 10, *sg.*). All the vessels of the sac are rather thick walled and opaque. The endostyle is like that of *Tylobranchion speciosum*.

There are about twenty languets. They are long and narrow, and are scarcely at all flattened (Pl. XXIII. fig. 12, *l.*). Each languet is continuous with one of the horizontal membranes (*h.m.*) of the branchial sac, and the series is connected by a slightly thickened ridge of epithelium (*ep.*), behind which are placed close together two parallel bands of muscle fibres (Pl. XXIII. figs. 11, 12, *m.f.*).

The tentacles are large and rather irregular in size and position. The dorsal tubercle is inconspicuous. It has a rounded opening placed near the base of the tentacles, and leading into a large infundibulum which may be traced into a narrow neural duct leading backwards behind the prebranchial zone. There is a well-marked peritubercular area formed by the bending posteriorly of the peripharyngeal bands, but the tubercle is placed far in front of it.

The œsophageal aperture is placed at the dorsal edge of the posterior end of the branchial sac, and leads at once into an elongated stomach which is directed posteriorly, and has its wall thrown into a series of strongly marked transverse folds. These are lined with columnar ciliated epithelium, and they form a conspicuous feature in the

otherwise simple alimentary canal. The intestine is thin walled and of great length. It stretches for a considerable distance beyond the stomach posteriorly, and then turns round to run forwards parallel to its first part and to the stomach. The intestinal loop is thus very long and narrow. The rectum does not extend very far forwards.

The post-abdomen contains both mature ova and spermatic vesicles, so that both reproductive elements seem to be formed in the Ascidiozooid at the same time in this species. The reproductive organs are not confined to the post-abdomen, but cover also a part of the long intestinal loop. The distance to which the post-abdomen may extend is very variable. The numerous spermatic vesicles are ovate or elliptical in form, and are united in groups by delicate ducts which join to form the vas deferens. This is a wide and rather conspicuous opaque tube which is coiled spirally and may be traced forwards alongside the intestine and rectum to the peribranchial cavity. In its entire extent its course is greatly convoluted. The mature ova are large and of an opaque yellow colour. Embryos and tailed larvæ are found in the peribranchial cavity, mainly on the dorsal edge, but there is no incubatory pouch. The tailed larvæ are large (Pl. XXIII. fig. 13), and have three very conspicuous adhering organs placed anteriorly. There is only one pigmented sense-organ, and it is placed near the posterior end of the body.

Atopogaster informis, n. sp. (Pl. XXIV. figs. 11–15).

The Colony must have been of large size, and probably was more or less rounded in form and not pedunculated. The colour is light grey, and the surface is rather uneven.

The Ascidiozooids are large, and have rather a long and narrow shape; they are about 1·2 cm. antero-posteriorly and 1 mm. in greatest breadth. The body is not distinctly divided into regions.

The Test is firm and cartilaginous. It is of a pale grey colour, and is fairly transparent. The homogeneous matrix is crowded with small rounded test cells, and no bladder cells are present.

The Mantle is moderately strong, and the musculature is well developed on the thoracic part of the body. The muscle bands are nearly all longitudinal, and they run with great regularity. There is little or no musculature on the abdomen and post-abdomen.

The Branchial Sac is fairly large, and the stigmata are numerous. The transverse vessels are wide and have no horizontal membranes. The stigmata are of moderate length and are regularly placed.

The Dorsal Lamina is represented by a series of short stout languets.

The Tentacles are large and numerous; they are all of much the same size.

Locality.—Unknown.

This species is based upon a fragment of a colony which was found in a bottle containing a number of pieces of Compound Ascidians preserved in absolute alcohol.

None of these have any localities attached to them, but most of them are merely pieces taken from colonies which occur in the collection, and therefore they can be readily referred to their proper species and localities. In the case of the present specimen, however, and one or two others, there is nothing else belonging to the same species in the collection, and therefore there is no clue to the locality from which it was obtained.

The specimen is a slice cut out of a large colony, and measures rather more than 9 cm. in length by about 4 cm. in greatest breadth and 1 cm. in thickness. From the shape of the specimen it is probable that the colony was a large rounded mass, and there is no evidence in favour of its having been pedunculated. It is impossible to say whether the colony was elongated from the base upwards or not, as, on account of the irregularity in the arrangement of the Ascidiozooids, it cannot be determined with certainty whether the slice was cut from the colony longitudinally or transversely.[1] The colour on the outside is simply that of the test, a warm light grey, as the Ascidiozooids are so scattered and so deeply placed in the colony as scarcely to show through at all. The large Ascidiozooids are of an opaque yellowish-brown colour, and are placed very irregularly in the test (Pl. XXIV. fig. 11). The body is nearly cylindrical and is not divided externally, but dissection shows that the branchial region occupies the anterior half or so, and the intestinal and genital parts the remainder.

The test is very compact, and has quite a cartilaginous feeling. It is of the same colour and structure throughout. The small test cells are very numerous, and in some places are densely crowded. No vessels are visible.

The mantle is not so thick as might be expected from the size and opacity of the body. The longitudinal muscle bands on the thorax are moderately strong, but they do not form a continuous layer. On the abdomen they become much thinner and gradually die away. The branchial siphon has six lobes, and the sphincter is well developed.

There are about twenty rows of stigmata in a large sized branchial sac, and there are usually about twelve in each row. The stigmata vary considerably in size in different sacs (see Pl. XXIV. figs. 12, 13, *sg.*), probably to a great extent according to the size and age of the Ascidiozooids. Figure 12 shows an average sized set of stigmata, while figure 13 was probably taken from a very young branchial sac. The endostyle is large and conspicuous, and has an undulating course.

The languets are tentacular in form, but very short (Pl. XXIV. fig. 14, *l.*) and rather closely placed. They are united by a distinct membrane (the dorsal lamina, Pl. XXIV. fig. 14, *d.l.*), behind which is placed a band of muscle fibres (*m.f.*).

The alimentary canal forms a long narrow loop. The stomach is long and has its thick wall folded transversely as in *Atopogaster aurantiaca*. The intestine is rather narrow, and undulates considerably in its course.

[1] I am inclined to think that it must have been a slightly oblique longitudinal section. If so, the colony would probably have been about 10 cm. in length and 4 cm. in breadth.

The reproductive organs occupy the post-abdomen, the region of the body behind the in testinalloop, and also encroach upon the abdomen. The usual median membranous septum is present in the post-abdomen. The ova and the spermatic vesicles occur together, and tailed larvæ were found in the peribranchial cavity of one Ascidiozooid. The larvæ (see Pl. XXIV. fig. 15) have two pigmented sense-organs placed far back in the body, and the tail has a very broad membranous margin.

Atopogaster elongata, n. sp. (Pl. XXIV. figs. 1–8).

The Colony is of an irregularly elongated form, attached by the one end, and more or less pointed at the other. It is usually somewhat compressed laterally, but may be almost cylindrical. The surface is uneven and moderately smooth. The general colour is a pale grey, but it varies in different specimens from brownish to almost white.

The length is about 10 cm., the greatest breadth 2·5 cm., and the thickness about 1 cm.

The Ascidiozooids are small, and are arranged quite irregularly. They are very numerous, and their anterior ends are closely placed all over the outer surface. The usual length of the Ascidiozooid is about 4 mm., while the greatest width is 0·4 mm. The body is not distinctly divided into regions.

The Test is compact and firm, and almost quite opaque. The matrix is homogeneous or very slightly fibrillated. The test cells are very numerous, and are generally of an elongated fusiform shape. There are no vessels and no bladder cells present in the test.

The Mantle is moderately strong. The muscle bands run mainly in a longitudinal direction; they are closely placed on the post-abdomen.

The Branchial Sac is of small size and its walls are opaque. The transverse vessels are relatively large, while the stigmata are variable in size; sometimes they are small and inconspicuous, while in other cases they are of moderate size.

The Tentacles are fairly large; they are closely placed and of different lengths.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

A large number of specimens of this species were obtained by the trawl at Station 313 in the Strait of Magellan. They differ from one another considerably in shape and size (see Pl. XXIV. figs. 1, 2, 3), but the colony is always of elongated form, attached by one end, and usually tapering slightly towards the other. In some cases the colony is twisted, the upper half or one-third being bent round so as to point towards the base of attachment (Pl. XXIV. fig. 3). The colony apparently never branches. In some cases there is considerable lateral compression, the thickness being much less than the breadth, but in other cases (or even other parts of the same specimen) the shape is

nearly cylindrical. The largest colony in the collection measures about 12 cm. in length, and the smallest 1·5 cm. in length and 8 mm. in greatest breadth.

The lower ends of the colonies have evidently been imbedded in gravel and sand, as they have masses of small stones and dark coloured sand-grains attached to the test for a distance of from 1 to 3 cm. above the base. In some few cases parts of the colony further up on one of the sides also show sand-grains imbedded in the test (Pl. XXIV. fig. 3), as if these colonies had grown in a recumbent in place of an erect position. The colour is generally of a dull pale yellowish-grey. It always becomes darker towards the base of attachment, and in a few specimens it is decidedly more of a yellowish-brown tint.

The Ascidiozooids are very numerous, but small. The thorax only occupies about one-fifth of the body, and the abdomen scarcely so much, while the rest is formed by the post-abdomen (see Pl. XXIV. fig. 4). The widest part is the thorax. There are no systems, and the Ascidiozooids seem to be crowded together without any regularity.

The test is firm and opaque except in thin slices. Its outer layer is rather tougher than the central mass, and the surface is slightly uneven, the anterior ends of the closely placed Ascidiozooids forming a number of small elevations. In its minute structure the test is remarkable on account of the immense abundance of the small cells, and of their fusiform shape (see Pl. XXIV. fig. 5, *t.c.*). In some places they are greatly elongated so as almost to form fibres, and they generally lie with their long axes parallel, so as to give the test in sections a somewhat striated or fibrillated appearance.

The mantle is, relatively to the size of the Ascidiozooid, moderately strong. The longitudinal muscle bands, which are rather distant on the thorax, become much more closely placed on the post-abdomen, where they form a strong muscular investment. The sphincter at the branchial aperture is well developed.

The branchial sac is relatively small and rather feebly developed. The stigmata are usually neither large nor very numerous. In some sacs, however (Pl. XXIV. fig. 6, *sg.*), they are of fair size and are wider than the fine longitudinal vessels. The ciliated cells are pointed. The endostyle is very wide and has an undulating course. The tentacles are irregular in length.

The alimentary canal does not extend very far behind the branchial sac. The œsophagus is short and narrow, and runs directly backwards (Pl. XXIV. fig. 7, *œ*). The stomach is large and more or less globular in form. It is rather wider anteriorly than posteriorly, and the wall is thrown into irregular transverse folds. The intestine is narrow. After leaving the posterior end of the stomach it runs backward for a short distance and then turns dorsally and anteriorly to form the rectum, which, after passing the stomach and œsophagus, ends in the peribranchial cavity.

The post-abdomen is large (see Pl. XXIV. fig. 4, *p.ab.*), usually about twice as long as the thorax and abdomen together, and it is wider than is usual amongst allied

forms. A few small ova may be found near its upper end in some Ascidiozooids, but the greater part of it is occupied by a mass of young and undeveloped spermatic vesicles. The vas deferens is not conspicuous, but may generally be made out running through the upper part of the post-abdomen and continued forwards alongside the rectum. No larvæ were found in any of the Ascidiozooids examined.

The posterior end of the post-abdomen (Pl. XXIV. fig. 4) forms a slightly swollen clear-walled bulb in which the heart lies, and it presents terminally a small knob which resembles a very rudimentary vascular appendage. The double septum traversing the post-abdomen is more conspicuous than usual (Pl. XXIV. fig. 4, *p.ab.*), and transverse sections show that its lumen is complicated and that its walls are formed in most places of large columnar cells (Pl. XXIV. fig. 8). The figure shows the ectoderm externally formed of squamous cells (*ec.*), and enclosing a great mass of rounded mesoderm cells (*mes.*) in which two cavities (*cæl.*) occur, one on each side of the median double septum, which is formed of columnar endoderm cells (*end.*) bounding a narrow lumen (*ar.*), which is, according to Kowalevsky, a prolongation of the posterior end of the branchial sac.

Atopogaster elongata, var. *pallida*, nov. (Pl. XXIV. figs. 9, 10).

The Colony is an irregular mass growing upwards from a broad base of attachment. It is rather elongated from the base upwards, and tapers slightly. The upper end is blunt. The colour is a pale opaque grey. The surface is very uneven, being cut up by deep grooves and ridges.

The length is 6·5 cm., the greatest breadth (above the base) is 3 cm., and the usual thickness is 2 cm.

The Ascidiozooids are small but very numerous, and are arranged quite irregularly. Their anterior ends are more opaque than the surrounding test, and appear as small dull yellow rounded spots. They are not distinctly divided into regions.

The Test is firm and massive, and is almost quite opaque. The small cells are exceedingly numerous; most of them are more or less rounded in form.

The Mantle is moderately strong, and most of the muscle bands run longitudinally.

The Branchial Sac is small and opaque. The stigmata are small rounded apertures.

Locality.—Simon's Bay; depth, 10 to 20 fathoms.

The specimen obtained at Simon's Bay, from which the preceding description has been taken, is very closely allied to *Atopogaster elongata*, and it is probably best to regard it as a variety of that species. The shape although still elongated from the base upwards is more irregular, the surface being strongly ridged and grooved (Pl. XXIV. fig. 9),

and the base is wide and spreading. This last character, however, is probably due to the circumstance that the colony is attached to a fragment of a large *Balanus* instead of being imbedded in the sand. The colour is much paler than in *Atopogaster elongata*, the test being of a dull whitish-grey, upon which the Ascidiozooids show as opaque yellowish-grey spots. The surface although uneven is in some places very smooth and glistening. The Ascidiozooids are small and numerous, and are scattered irregularly over the surface just as in the case of *Atopogaster elongata*. They are more numerous at the upper end of the colony than near the base of attachment, and this causes a slight difference in appearance; the lower part being greyer in colour.

The Ascidiozooids are elongated antero-posteriorly, are usually about 3 or 4 mm. in length, and are not clearly divided into regions. The widest part is about one-fourth of the way back, and the post-abdomen occupies the greater part of the body and is of considerable thickness. The whole body is quite opaque.

The test cells are rather large (Pl. XXIV. fig. 10, *t.c.*), and have usually a granular appearance. The opacity of the test is probably due in great part to the abundance of these cells. The shape of the cells, which are ovate or rounded, is quite different from that of the test cells in *Atopogaster elongata*, where the elongated fusiform cells give a characteristic appearance to sections of the test (compare Pl. XXIV. fig. 5 with Pl. XXIV. fig. 10).

The mantle is very like that of *Atopogaster elongata*. There are usually three or four muscle fibres in each of the longitudinal bands.

The branchial sac is rather smaller and the stigmata more rudimentary than in the case of *Atopogaster elongata*. The alimentary canal forms a short loop.

In other respects this variety appears to agree closely with the specimens of the species from Station 313.

Morchellioides, n. gen.

Colony massive, sessile.

Systems compound, inconspicuous.

Ascidiozooids elongated, but not distinctly divided into regions. Branchial aperture eight-lobed.

Test gelatinous.

Branchial Sac large and well developed.

Alimentary Canal large. Wall of stomach irregularly thickened.

Post-Abdomen large, but not distinctly separated from the abdomen.

The species for which this section is proposed agrees with the genera *Morchellium*, Giard, *Synoicum*, Phipps, and *Sidnyum*, Savigny, in having the wall of the stomach

areolated or thickened irregularly so as to form a series of knobs or very short cæca; but it differs from all of these groups in having the branchial aperture surrounded by eight lobes in place of six. This last feature it possesses in common with Giard's two genera *Circinalium* and *Fragarium*, from both of which it is separated by the structure of the stomach-wall. Amongst those genera with areolated stomachs (see Table, p. 152) *Morchellioides* is most nearly related to *Morchellium* on account of the compound systems and the sessile post-abdomen; and amongst genera with more than six lobes round the branchial aperture it is most nearly related to *Fragarium*, again, on account of the compound systems. Consequently the nearest allies of the present genus appear to be:—on the one side *Morchellium*, with only six lobes round the branchial aperture, and on the other *Fragarium*, with a folded or ridged stomach-wall.

The genus *Parascidia* was founded by Milne-Edwards for the reception of forms allied to *Amaroucium*, but having eight-lobed branchial apertures, and Alder very properly referred to that genus the species described by Fleming and Forbes under the name of *Sidnyum turbinatum* along with a species of his own, all of them being characterised by eight-lobed branchial apertures. *Parascidia* must be very closely related to *Fragarium*, *Circinalium*, and *Morchellioides*, but unfortunately none of the published accounts of it are sufficiently detailed to show whether or not it is distinct from all of them. *Morchellioides* can be separated from *Fragarium* and *Circinalium*, but may possibly be the same as *Parascidia*.

Further points in the structure of the present genus will be found noted under the description of the single species which follows.

Morchellioides affinis, n. sp. (Pl. XXIV. figs. 16–20).

The Colony is an irregularly globular or dome-shaped mass attached by a wide base and slightly compressed laterally. The widest part is a little way above the base, and the top is rounded. The surface is even, but finely roughened all over. The colour is a warm yellowish-grey.

The length is 4 cm., the greatest breadth is 3 cm., and the thickness is about 2·5 cm.

The Ascidiozooids are numerous and fairly large. They are very distinctly visible all over the colony, and are not arranged in regular systems. They are usually about 7 mm. in length and 1 mm. in breadth, and the body is not distinctly divided into regions externally. The widest part of the body is in the branchial region. Vascular appendages are given off from the posterior end of the body.

The Test is thick and moderately firm. It is of a light grey colour and is semi-transparent. The test cells are small but very numerous. There are no bladder cells and no pigment corpuscles, but a few rather narrow vessels are present; they end in slightly dilated knobs.

The Mantle is rather delicate. The muscle bands are all longitudinal in direction; they are narrow and not numerous.

The Branchial Sac is large and well developed. The transverse vessels are all of the same size. The stigmata are large and regular.

The Dorsal Lamina is represented by a series of large languets.

The Tentacles are of fair size. There are about a dozen of them, all of much the same length.

The Alimentary Canal is rather large. The stomach has its wall irregularly thickened, and the rectum is very wide.

The Post-Abdomen is long and narrow. Its posterior end is prolonged into several ectodermal appendages with slightly dilated ends.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

This species in general appearance is very similar to *Amaroucium variabile*, but differs from it in the structure of the stomach-wall and in having eight lobes round the branchial aperture. It is also related to *Morchellium giardi* and to *Fragarium elegans*, Giard.

There are two colonies in the collection, both from Kerguelen Island, 10 to 60 fathoms. They are large rounded lumps (Pl. XXIV. fig. 16) with no peduncles, and having a more regular form than most of the specimens of *Amaroucium variabile* from the same locality have; otherwise they resemble that species. The dimensions of the larger colony are given above; the smaller one measures 3 cm. in length, 2·5 cm. in greatest breadth, and 1·5 cm. in thickness. Several common cloacal apertures can be made out on the surface of each colony. There are no very obvious systems, but the Ascidiozooids, though scattered all over the surface, seem to be arranged along the borders of meandering lines radiating from the common cloacal apertures (Pl. XXIV. fig. 16). The anterior ends of the Ascidiozooids show as opaque pale yellow circular spots upon the grey test. They give a yellowish tinge to the colony as a whole.

The Ascidiozooids are fairly large, and the thorax is relatively of larger size than is usual in the Polyclinidæ. The posterior part of this region is considerably wider than any other part of the body. There is no marked constriction where the thorax joins the abdomen or where the abdomen joins the post-abdomen.

Considering its mass, the test is not very solid. The minute test cells present the usual variety of shapes; they are very abundant. The vessels are small and rarely met with, as they do not extend far from the posterior ends of the Ascidiozooids. They terminate in slight bulbs (Pl. XXIV. fig. 17, *t.k.*).

The mantle is weak considering the size of the body. The atrial aperture is provided with a very long tapering atrial languet. The branchial aperture is provided with eight regular and very prominent rounded lobes (Pl. XXIV. fig 19, *br.l.*). It

is rather remarkable that this form, so closely allied to other species of the Polyclinidæ, should differ from them in the number of lobes surrounding the branchial aperture, a feature which is in most Ascidians a diagnostic character of great importance and constancy.

The branchial sac is of considerable length, and may have as many as fourteen rows of stigmata upon each side. In most cases the anterior half of the sac is narrower than the posterior, and the stigmata in the wider part are rather larger than elsewhere. There are as many as eighteen stigmata in the larger rows, and they are usually wider than the fine longitudinal vessels between them. The transverse vessels are provided with muscle fibres, and are usually very regular and uniform, but in one sac I found a transverse vessel bifurcating (Pl. XXIV. fig. 18) so as to produce a new row of stigmata, a condition frequently seen in some Simple Ascidians, but exceedingly rare amongst Compound Ascidians. The ciliated cells bounding the stigmata are large and distinct.

The endostyle is large. The dorsal languets are tentacular in shape and rather blunt.

The œsophagus is a gradually widening tube which leads from the posterior end of the branchial sac directly backwards to the large stomach (Pl. XXIV. fig. 20, *œ.*). The stomach is irregularly pear-shaped, and its wall in place of being thrown into ridges as in *Amaroucium variabile* and other allied forms, is raised into a series of knobs projecting from the surface, on which the epithelium is greatly thickened. These knobs are placed in irregular rows extending antero-posteriorly along the stomach (Pl. XXIV. fig. 20, *cœ.*). There can be no doubt that this peculiar condition is simply the result of the breaking up of the longitudinal folds or ridges so common in the stomachs of Compound Ascidians into rows of detached knobs. The intestine extends for a considerable distance beyond the stomach and then turns sharply towards the dorsal side and anteriorly, to form a very narrow loop. It then becomes the thin-walled wide rectum, which runs forwards along the dorsal edge of the abdomen and thorax. The post-abdomen varies considerably in size, usually it is rather narrow. Its prolongation to form ectodermal tubes or vessels which branch through the test (Pl. XXIV. fig. 17, *v.ap.*) is remarkable, since it is a condition very rarely seen in the Polyclinidæ.

Reproductive organs were not developed in many of the Ascidiozooids examined. When they are present, the vas deferens is large and conspicuous. Its course is very undulating.

Morchellium, Giard.

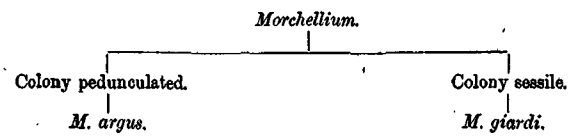
Amaroucium, Milne-Edwards, Observations, &c., 1842 (in part).
Morchellium, Giard, Recherches sur les Ascidies composées ou Synascidies, Archives d. Zool. expér., &c., vol. i. p. 641, 1872 (as a subgenus).

Colony massive, sessile, or pedunculated.
Systems compound, irregular, and usually inconspicuous.
Ascidiozooids elongated but not distinctly divided into regions. Branchial aperture six-lobed.
Test gelatinous or cartilaginous.
Branchial Sac large and well developed.
Alimentary Canal usually large. Wall of stomach irregularly thickened.
Post-Abdomen large, but not distinctly separated from the abdomen.

This group was formed as a subgenus of *Aplidium* by Giard in 1872 for the reception of a single species, *Morchellium argus*, the *Amaroucium argus* of Milne-Edwards. It was characterised by the long, sessile post-abdomen, the compound irregular systems, and the areolated stomach. The last feature is an important one which this genus shares along with *Sidnyum*, *Synoicum*, and *Morchellioides*. From the first of these forms *Morchellium* is distinguished by its post-abdomen not being separated from the abdomen by any constriction, while it differs from the second in having compound irregular systems. *Morchellioides* is separated from all of these by having eight lobes round the branchial aperture.

The condition of the stomach-wall in these four genera is very interesting. In place of being thrown into longitudinal or transverse folds it is irregularly thickened, the result being the production of a series of knobs or very short cæca projecting outwards (see Pl. XXV. fig. 3). In the case of *Morchellioides affinis* these cæca form a system of irregular longitudinal lines suggesting that the areolated condition is the result of the breaking up of a series of longitudinal folds; while in *Morchellium giardi* and *Sidnyum pallidum* they are more irregularly placed.

No species have been added to the genus *Morchellium* since it was instituted by Giard in 1872, and the new species described below belongs to the southern hemisphere, and differs very considerably in structure from the type species. The genus may be divided as follows:—



Morchellium giardi, n. sp. (Pl. XXV. figs. 1–3).

The Colony is of rudely hemispherical form and is attached by a small area in the centre of the lower surface. The upper surface is broad and convex, the lower is smaller and usually flattened or slightly concave. There is no lateral compression. The surface is even but not smooth. The colour is a dull pale brown.

The length is 1·8 cm., the breadth 2·5 cm., and the thickness 2 cm.

The Ascidiozooids are of moderate size and fairly numerous. They are placed vertically in the colony and are arranged in systems around the common cloacal apertures, of which there are a good number on the upper surface of the colony. The body of the Ascidiozooid is usually about 5 mm. or 6 mm. in length and 1 mm. in breadth; it is not distinctly divided into regions.

The Test is firm and cartilaginous. It is of a greyish-brown colour and is rather opaque. The test cells are small but very numerous. Most of them are fusiform or branched, and their protoplasm is granular. No bladder cells are present.

The Mantle is thin and transparent and not very muscular. The longitudinal muscle bands are fairly strong, but are placed far apart.

The Branchial Sac is large and well developed. The transverse vessels are numerous and all of the same size. The stigmata are long and narrow and arranged with great regularity.

The Dorsal Lamina is represented by a series of large languets.

The Tentacles are numerous and closely placed.

The Alimentary Canal forms a long narrow loop. The stomach has its wall irregularly thickened.

The Post-Abdomen is large and quite opaque.

Locality.—Royal Sound, Kerguelen Island, January 19, 1874; depth, 20 to 60 fathoms.

Four specimens of this species were obtained in Royal Sound, Kerguelen Island. They are all of rounded form, flattened from above downwards so as to present a somewhat hemispherical appearance in side view (Pl. XXV. fig. 1). The place of attachment is sessile, and usually occupies the middle third or so of the flattened lower surface. The colour is characteristic. It is a dull brown with a slight olive-green shade. A few sand-grains are found adhering to the surface in different parts of the colony, even on the upper surface.

The largest specimen is nearly 3 cm. in its greatest extent (breadth), and the smallest is 1·3 cm. in length, 1·9 cm. in breadth, and 1·5 cm. in thickness. There are a considerable number of systems in each colony. Fifteen common cloacal apertures are visible on the upper surface of one colony and twelve on another. They are small, circular or

elliptical in outline, and have the Ascidiozooids arranged in a circle around them (Pl. XXV. fig. 1), consequently the systems resemble those of the genus *Botryllus* in outline. Parasitic Crustaceans were found in some of the cloacal cavities. The anterior ends of the Ascidiozooids are seen on the upper surface of the colony as small round spots, and the bodies are visible on the sides of the colony in the form of pale yellow streaks. In sections the Ascidiozooids are seen to be equally numerous in all parts of the colony.

The test is very tough and solid, and is of the same colour and consistence throughout. In some places the matrix is delicately fibrillated. The test cells are more abundant in the outer layer than elsewhere; they are mostly fusiform, and are arranged with their long axis parallel to the surface. They are nearly all granular and opaque, while the surrounding matrix is clear and transparent.

The longitudinal muscle bands in the mantle are very regular, but narrow; on the post-abdomen they are less regular; they are broader, but placed further apart, on the thorax; and are almost absent on the abdomen. The branchial aperture is six-lobed. The branchial siphon is long and narrow, and the sphincter is well developed. In some parts of the thorax the muscle bands are rather irregular in their arrangement and anastomose with one another.

There are about twelve rows of stigmata in the branchial sac. The transverse vessels are strong, and are provided with double muscle bands (Pl. XXV. fig. 2, *m.f.*). The anterior band of one vessel is connected at the dorsal and ventral edges with the posterior band of the vessel in front, and the posterior band of the first vessel is connected at the edges with the anterior band of the vessel behind, so that a continuous band of muscle fibres encircles each row of stigmata (see Pl. XXV. fig. 2). The effect of the contraction of these muscles of the branchial sac would probably be to corrugate the stigmata and interstigmatic vessels and so diminish the size of the sac as a whole. Probably this action takes place when the mantle contracts and water is forced out through the branchial and atrial apertures simultaneously. The stigmata are usually equal in breadth to the fine longitudinal vessels. The ciliated cells are large and distinct.

The dorsal languets are large and of an elongated triangular form. They are numerous and closely placed. The endostyle is large and conspicuous. The tentacles are of two sizes placed alternately; they are large. The nerve ganglion is ellipsoidal in shape and of large size.

The œsophagus is of moderate length and runs directly backwards to open into the large ellipsoidal stomach (Pl. XXV. fig. 3). The wall of the stomach is folded so as to form a number of detached knobs with thickened epithelium projecting from the surface. This structure recalls the condition of the stomach in *Morchellioides affinis*, but in the present case the knobs or cæca are more numerous and are less distinctly placed in rows (Pl. XXV. fig. 3, *st.*). In a transverse section of the stomach

there are generally from fifteen to twenty visible. The intestine runs posteriorly from the stomach for some distance (Pl. XXV. fig. 3, *i.*), and then turns abruptly towards the dorsal edge, and then anteriorly, so as to form a narrow loop. The rectum is wide and rather thin walled.

The post-abdomen is nearly as wide as the abdomen, but is not very long. In transverse sections it shows the usual double median septum with a slit-like lumen and the two lateral cavities surrounded by masses of opaque granular cells. A few young ova were seen in the anterior part of one post-abdomen, but the reproductive organs seemed to be in an undeveloped condition in the other Ascidiozooids examined.

Sidnyum, Savigny.

Sidnyum, Savigny, Mémoires, &c., addition, p. 238, 1816.
Sidnyum, Giard, Recherches, &c., Archives d. Zool. expér., vol. i. p. 635, 1872.
non *Sydneum*, Fleming, British Animals, p. 469, 1828.
non *Sidnyum*, Alder, Trans. Tyneside Naturalists' Field Club, vol. i. p. 109, 1848.
non *Sidnyum*, Forbes, British Mollusca, vol. i. p. 13, and vol. ii. p. 369, 1853.

Colony massive, or formed of a number of lobes, one corresponding to each system.
Systems compound.
Ascidiozooids elongated and distinctly divided into regions; branchial aperture six-lobed; atrial aperture not provided with a languet.
Test gelatinous.
Branchial Sac well developed.
Alimentary Canal forming a narrow loop. Stomach-wall irregularly thickened.
Post-Abdomen long, and separated from the abdomen by a constriction.

This genus was formed by Savigny for a species which he briefly described in an appendix to his "Mémoires," published in 1816. The specimen, which he named *Sidnyum turbinatum*, had been found in British Seas by Leach and sent by him to Savigny. Its characteristics led Savigny to place it between *Synoicum*, Phipps, and his own genus *Aplidium*. He pointed out the similarity in the structure of the stomach-wall existing between *Sidnyum* and *Synoicum*, and described the post-abdomen as pedunculated, a point in which the two genera differ. Giard in his classification of the Polyclinidæ recognised *Sidnyum*, but was apparently unable to decide whether it belonged to the genus *Aplidium* or the genus *Polyclinum* of his system.

The new species which is described below, although agreeing in all essential characters with Savigny's *Sidnyum turbinatum*, differs greatly in external appearance, and the two forms may therefore be readily distinguished. *Sidnyum pallidum* forms a globular mass with a broad and rounded upper surface (Pl. XXV. fig. 4), while in *Sidnyum*

turbinatum each system forms a separate lobe in the form of a truncated cone projecting from the surface of the colony.

The specimens described as *Sidnyum turbinatum* by Professor E. Forbes[1] and by Dr. Fleming[2] are, according to Alder,[3] not that species, but belong to a separate but allied genus *Parascidia*, Milne-Edwards, characterised by an eight-lobed branchial aperture. Alder named them *Parascidia forbesii* and *Parascidia flemingii*, and described a third species *Parascidia flabellata*.

Sidnyum pallidum, n. sp. (Pl. XXV. figs. 4-6).

The Colony is of irregularly globular form, and is attached by a small area at the lower end. The upper surface of the colony is broad and rounded. There is no lateral compression. The surface is moderately even but not smooth. The colour is a pale but dull grey.

The length is 1·5 cm., the breadth is 1·7 cm., and the thickness is 1·4 cm.

The Ascidiozooids are of moderate size and fairly numerous; they are arranged in systems around the common cloacal apertures, which are small but distinct. The body of the Ascidiozooid is long and narrow, being usually about 8 or 9 mm. in length and less than 1 mm. in breadth. It is of a very pale yellow colour and semi-transparent. The three regions of the body are clearly distinguishable.

The Test is soft and flexible. It is of a light grey colour and is transparent. The test cells are small but numerous. There are no bladder cells present.

The Mantle is thin and transparent. The musculature is feeble. The muscle bands are all longitudinal in direction; they are narrow and not closely placed.

The Branchial Sac is well developed. There are about twelve transverse vessels, all of the same size. The stigmata are small but well formed, and are regularly arranged.

The Dorsal Lamina is represented by a series of short stout languets.

The Alimentary Canal is relatively very long, and forms a narrow loop. The stomach is globular and has its wall irregularly thickened.

The Post-Abdomen is long and less opaque than usual. It contains both male and female reproductive organs.

Locality.—Off Marion Island, depth 50 to 75 fathoms.

This species, although it resembles *Morchellium giardi* in some respects, is quite distinct from that and all previously described species both in external appearance and internal

[1] British Mollusca, vol. i. p. 13, 1853.

[2] British Animals, p. 469, 1828. The specimen was found by Dr. Fleming on the shores of the Isle of May in the Firth of Forth.

[3] *Ann. and Mag. Nat. Hist.*, ser. 3, vol. xi. p. 152, 1863.

structure. Two colonies of about the same size were obtained near Marion Island, between the Cape of Good Hope and Kerguelen Island, in from 50 to 75 fathoms of water.

There is no peduncle, the pale grey rounded mass being simply attached by a small portion of its surface (Pl. XXV. fig. 4). The colour may become darker in places from the presence of small patches of minute sand-grains adhering to the surface. The systems are clearly visible on the upper part of the colony, as the anterior ends of the Ascidiozooids show through the transparent test very distinctly. The bodies are unusually elongated. A specimen 9 mm. in length has the thorax 2·5 mm. in length, the abdomen 2·5 mm., and the post-abdomen 4 mm. The thorax is the widest part (Pl. XXV. fig. 6, *th.*).

The outer layer of the test is rather firmer than the inner part. The test cells are mostly of rounded form, though some are stellate or branched. The protoplasm of these cells is generally coarsely granular.

The muscle bands in the mantle are all delicate, and on the abdomen and post-abdomen they are particularly narrow. The branchial siphon is short, and the sphincter muscle is not well developed. The branchial aperture is obscurely six-lobed. The atrial aperture is placed at the end of a siphon and is six-lobed. No atrial languet is present.

Thebranchial sac is rather like that of *Morchellium giardi* (compare figs. 2 and 5 on Pl. XXV.). The transverse vessels are moderately wide (Pl. XXV. fig. 5, *tr.*), and are provided with muscle bands having the arrangement around the rows of stigmata at the dorsal and ventral edges which is described on p. 182 (see Pl. XXV. fig. 2, *m.f.*). The stigmata are equal in width to the fine longitudinal vessels. The dorsal languets are broader and very much shorter than those of *Morchellium giardi*. The endostyle is conspicuous, its course is undulating.

The œsophagus is a long narrow curved tube with the convexity dorsal (Pl. XXV. fig. 6, *œ.*). It enters the stomach on its outer or dorsal edge about half way down. The stomach is nearly globular in shape, and has its wall thickened irregularly so as to form a number of short cæcal processes like those seen in the case of *Morchellioides affinis* and *Morchellium giardi*. The cæca are not arranged in rows (Pl. XXV. fig. 6, *st.*). The intestine is at first a wide tube. It runs directly backwards from the posterior end of the stomach for a short distance, and then turns ventrally and towards the right hand side to become the rectum; the intestinal loop is very narrow, and the most posterior part of the intestine is of small calibre. The rectum is a large thin-walled tube. It runs forward on the ventral and right hand edge of the stomach, and then turns dorsally, crossing on the right hand side of the œsophagus. It runs for a short distance along the dorsal edge of the thorax, and then terminates by opening into the peribranchial cavity.

The post-abdomen is separated from the rest of the body by a slight constriction. The reproductive organs in all the Ascidiozooids examined occupied only a small portion

of the post-abdomen, and the remainder was much less opaque than usual. The ova are found in a small group, usually placed near the anterior end (see Pl. XXV. fig. 6, *o.*), and are united by narrow tubular pedicels.

The spermatic vesicles are pyriform and of small size. The vas deferens is narrow but distinct, and may be traced from the post-abdomen forwards through the abdomen and thorax, where it lies alongside the rectum (see Pl. XXV. fig. 6, *v.d.*).

Polyclinum, Savigny.

Polyclinum, Savigny, Mémoires, 1816.
Polyclinum, Milne-Edwards, Observations, &c., 1842.
Polyclinum, Forbes, British Mollusca, vol. i. p. 14, 1853.
Polyclinum, Giard, Recherches, &c., Archives de Zool. expér., vol. i. p. 641, 1872.
Polyclinum, von Drasche, Die Synascidien, 1883.

Colony massive, usually sessile.

Systems simple or compound, often irregular.

Ascidiozooids elongated, more or less distinctly divided into three regions; branchial aperture six-lobed; atrial aperture provided with a languet.

Test gelatinous or cartilaginous, sometimes incrusted with sand.

Branchial Sac large and well developed.

Alimentary Canal usually long and complicated, often twisted; stomach smooth walled.

Post-Abdomen separated from the abdomen by a distinct constriction, often projecting from one side of the intestinal loop.

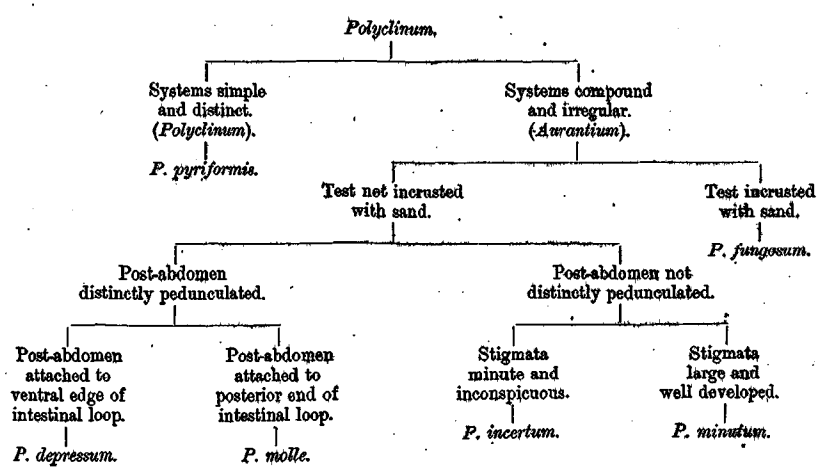
Savigny in characterising this genus laid stress upon the distinct but often irregular systems, each provided with a common cloaca, the six lobes of the branchial aperture and the well-developed atrial languet, the large branchial sac, and the distinct division of the body of the Ascidiozooid into three regions. These characters, however, are not sufficient to distinguish the genus from some of the other Polyclinidæ, and consequently subsequent authors have added to and modified them considerably. Giard pointed out that in many species of *Polyclinum* the alimentary canal is so twisted that the rectum crosses over the right side of the stomach. He considered this disposition of the intestinal loop as the most important character of the genus, and one which distinguished it from all the other Polyclinidæ. Von Drasche, however, found it necessary to modify Giard's definition slightly, so that *Polyclinum* might include forms where the alimentary canal was so placed that the stomach lay not on the left side of, but anteriorly to, a part of the rectum. I have met with both of these arrangements and also with others which seem to show a gradual transition between the twisted condition found in Savigny's species[1]

[1] See his Mémoires, pls. xviii. and xix.

and the simple loop characteristic of *Aplidium* and *Amaroucium*. Consequently I question the great value of the intestinal twist as a diagnostic character, and I feel inclined rather to put my trust in a combination of characters, which are:—The separation of thorax, abdomen, and post-abdomen, and the somewhat lateral position of the latter, the twisting of the intestine, and the smooth-walled stomach. In regard to the last-named character, on which I would lay some stress, Savigny figures a perfectly smooth stomach in all his species of *Polyclinum*, and all the species which I have examined, and which seem to me to belong to this genus, have the stomach-wall smooth and free from all folds or irregular thickenings, an unusual condition in the Polyclinidæ. Consequently I have come to consider this simple type of stomach as one of the most important if not the primary characteristic of the genus *Polyclinum*.

Giard subdivided the genus, according to the condition of the systems, into (1) *Aurantium*, in which they are compound, and (2) *Polyclinum* proper, in which they are simple. According to this classification, all of the Challenger species, with the exception of *Polyclinum pyriformis*, would probably be placed under *Aurantium*, but, as it is exceedingly difficult, if not indeed impossible in some cases, to determine with certainty the condition of the systems in specimens preserved in alcohol, I have considered it best for the present to regard *Polyclinum* and *Aurantium* as forming one group. When the species described below come to be examined afterwards in the living condition, those of them with compound and irregular systems can, if their investigator confirms my suspicions as to their condition, be transferred to the genus *Aurantium*, leaving *Polyclinum pyriformis* as the sole representative of *Polyclinum* in the Challenger collection.

The new species may be distinguished by the following characters:—



Polyclinum pyriformis, n. sp. (Pl. XXVI. figs. 1–4).

The Colony is pyriform and is attached by a short stalk formed by a prolongation of the narrower end of the colony. The upper end is wide and rounded. There is little or no lateral compression. The surface is regular and smooth. The colour is a light greyish-yellow.

The length is 3 cm. (of which 8 mm. is formed by the stalk), the breadth is 2·2 cm., and the thickness is about 1·7 cm.

The Ascidiozooids are large and very numerous; they are arranged in systems around the common cloacal apertures, of which there are several on the upper surface of the colony. The Ascidiozooid is usually about 12 mm. in length and 1·5 mm. in breadth. The body is distinctly divided into three regions.

The Test is soft and gelatinous in the upper part of the colony; it becomes firmer on the peduncle. It is of a light grey colour and very transparent. The test cells are small and not very numerous; they are usually triangular or stellate, and frequently have long branched prolongations. There are no bladder cells.

The Mantle is thin and transparent. The musculature is rather weak, and is mainly longitudinal in direction.

The Branchial Sac is large and well developed. The transverse vessels are all of the same size. The stigmata are long and narrow, and are arranged with regularity.

The Endostyle is long and narrow but conspicuous.

The Dorsal Lamina is represented by a series of languets.

The Tentacles are large and closely placed; there are about twelve of them, all of the same size.

The Alimentary Canal forms a short wide loop. The stomach is large and its wall is smooth.

The Post-Abdomen is long but narrow.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

This species has a certain external resemblance to *Amaroucium globosum*, which was obtained at the same locality on the shores of Kerguelen Island. The two species are, however, quite distinct, although allied forms. There are two specimens of *Polyclinum pyriformis* in the collection, and both are very distinctly pear-shaped and shortly pedunculated (Pl. XXVI. fig. 1). The dimensions given in the above description are those of the large specimen. The smaller one is 2·3 cm. in length (including peduncle), 1·3 cm. in breadth, and 1·1 cm. in greatest thickness.

The yellow colour of this species is due mainly to the abundance of the Ascidiozooids, which are of an opaque yellow colour and very distinctly visible through the transparent test. The Ascidiozooids are arranged in fairly regular circular systems (Pl. XXVI.

fig. 1). The common cloacal apertures are circular, and vary from 1 mm. to 2 mm. in diameter. There are usually about eight Ascidiozooids in a system. On the upper surface of the colony the wide anterior ends of the Ascidiozooids are distinctly visible. They show the branchial aperture with its six lobes and the anterior extremity of the endostyle. On the sides of the colony the abdominal and post-abdominal regions are seen (Pl. XXVI. fig. 1). In a body 12 mm. long the thorax is about 4 mm. in length, the abdomen 3 mm., and the post-abdomen 5 mm. In some cases the post-abdomen is relatively much longer. It extends down to the top of the peduncle.

The test in the upper part of the colony is small in amount, as the Ascidiozooids are very closely placed (Pl. XXVI. fig. 1). The outer surface is firmer than the inner part, and can be torn off as a distinct membrane. The ectoderm adheres very firmly to the test, and consequently it is sometimes a little difficult to separate the thoracic part of the Ascidiozooid from the test, and patches of the ectoderm and even small pieces of the mantle are occasionally left adhering to the test. The mantle is unusually delicate, and recalls that of some species of *Colella* in the Distomidæ. The branchial aperture is distinctly six-lobed, but the sphincter is feebly developed (Pl. XXVI. fig. 4, *br.*).

The branchial sac is usually about 4 mm. in length and 1·5 mm. in breadth. The number of transverse vessels is usually over twelve, and the stigmata are always well developed. There is a considerable amount of variability, however, in the size of the transverse vessels and the length of the stigmata. The characters appear to be constant throughout the same sac, but differ in the Ascidiozooids of one colony. Figures 2 and 3 on Plate XXVI. show two extreme conditions. In figure 3 the transverse vessels are as wide as the length of the stigmata, while in figure 2 they are much narrower and the stigmata are larger. Each transverse vessel has a bundle of muscle fibres running along it (Pl. XXVI. fig. 2, *m.f.*). The ciliated cells bounding the stigmata are always large and distinct.

The dorsal languets are triangular, rather short, and flattened antero-posteriorly (Pl. XXVI. fig. 3, *l.*). On account of the transparency of the mantle and branchial sac the endostyle is always a conspicuous object in dissections. It is unusually narrow, and does not undulate from side to side.

The œsophagus (see Pl. XXVI. fig. 4, *œ*) is long, narrow, funnel-shaped, and curved with the convexity dorsal. It leaves the branchial sac at the dorsal edge of the posterior end. The stomach is large and ovate in shape, and its long axis is directed posteriorly and ventrally (Pl. XXVI. fig. 4, *st.*). The œsophagus joins it by a small circular aperture on its inner or dorsal edge about the junction of the anterior and middle thirds. The wall of the stomach is not folded or thickened in any part. The intestine leaves the posterior end of the stomach and curves posteriorly and dorsally, narrowing until it reaches its most posterior point (Pl. XXVI. fig. 4, *i.*), where it enlarges to form a spindle-

shaped dilatation before turning anteriorly to become the rectum. The intestine is thin walled, and it forms an open loop. The spindle-shaped dilatation and the rectum are separated by a constriction (Pl. XXVI. fig. 4, *i'*.). The rectum is wide and forms the dorsal edge of the abdomen and a considerable portion of the thorax (Pl. XXVI. fig. 4, *r*.). The anal aperture is small, with a reflected margin.

The mantle over the abdomen is considerably pigmented, especially in its posterior part, around the intestinal loop. The pigment granules are opaque white. The post-abdomen is very variable in length. It is of a dull yellow colour and is quite opaque, except along the middle line, where a narrow undulating clear streak represents the lumen of the septum.

Polyclinum fungosum, n. sp. (Pl. XIV. figs. 15–23).

The Colony has a plano-convex discoid form. It is nearly circular in outline. The lower surface is almost flat, and the point of attachment is at its centre; there is no peduncle. The upper surface is irregularly convex. The colour is a dark dull grey. The surface is uneven, and is roughened all over by a layer of small sand-grains adhering to the surface. No common cloacal apertures are visible.

The length (from the place of attachment to the highest point) is 1·6 cm., the breadth 3·3 cm., and the greatest thickness 2·8 cm.

The Ascidiozooids are very long, and are placed at right angles to the upper surface. The largest measure about 8 mm. in antero-posterior extent and about 2 mm. in greatest breadth. The anterior end is not wide. It forms a small projection on the surface of the colony about 1 mm. in diameter.

The Test is soft but fairly firm. The outer layer is strengthened by imbedded and attached sand-grains and shell fragments. It is quite opaque and of a dull grey colour. In sections of the deeper layer of test the homogeneous matrix is seen to contain many small rounded cells; the usual fusiform and stellate shapes are absent or rare. No bladder cells are present.

The Mantle is rather thin. The transverse muscle bands are fairly strong, but are placed far apart. The branchial sphincter is well developed.

The Branchial Sac is very long and narrow. The transverse vessels are all similar, and are of moderate size. They have horizontal membranes attached to their inner edges. The stigmata are long and narrow, usually with rounded ends. They are very regularly placed.

The Dorsal Lamina is formed of a series of long pointed languets.

The Tentacles are very numerous and closely placed. There are about twenty very long and thin tentacles and some intermediate smaller ones.

The Dorsal Tubercle is a rounded opening placed near the base of the tentacles. The neural duct is very large. There is no peritubercular area.

The Reproductive Organs are large; they are hermaphrodite.

Locality.—Port Jackson, Australia; depth, 6 to 15 fathoms.

This is an interesting species. From its external appearance and its essential structure, it belongs to the Polyclinidæ, but from some points in its internal anatomy it seems allied to *Colella* and the other Distomidæ. There is only one specimen in the collection. It was obtained at Port Jackson, Australia, from a depth of 6 to 15 fathoms.

In shape the colony is somewhat like a Fungus, being an irregularly discoid mass, flat below and rounded above (see Pl. XIV. fig. 16). From near the middle of the lower surface there projects a mass of mud, &c., from 1 cm. to 1·5 cm. in diameter, which indicates the point of attachment of the colony. This spot is seen in the side view (Pl. XIV. fig. 16) and still better in the vertical section (Pl. XIV. fig. 17). The rounded upper surface (Pl. XIV. fig. 15) rises from the edge on all sides, but the slope varies, as may be seen by comparing the edges in figures 16 and 17. The edge nearly all round is thickened and slightly upturned (Pl. XIV. fig. 17). The upper surface is covered all over with small rounded areas like flattened papillæ (Pl. XIV. figs. 15, 16). These are the anterior ends of the Ascidiozooids. They seem to be arranged quite irregularly, and are incrusted like the rest of the surface with adhering sand-grains. A vertical section through the colony (Pl. XIV. fig. 17) shows that the Ascidiozooids are placed very closely side by side and reduce the test to narrow bars and membranes. They are all placed vertically, and they vary greatly in size, those in the centre—the highest part of the colony—being fully 8 mm. in length, while those at the edge measure only 4 mm.

The opaque dull grey colour of the colony is due in great part to the surface layer of sand, the test below being of a much lighter grey and fairly transparent. There is really comparatively little test in this colony, the greater part of the mass being formed by the bodies of the Ascidiozooids. The test cells are notable on account of the absence of the long delicate processes so common in most other Ascidians; here they are nearly all rounded or ovate in form.

The mantle has regularly arranged transverse muscle bands which encircle the branchial part of the body, and a few smaller irregularly running bundles. The branchial siphon is small, and is distinctly six-lobed at its free end.

The branchial sac is exceedingly long and narrow. It extends along the greater part of the body of the Ascidiozooid. There are in the mature sac ten or twelve rows of stigmata upon each side, and each row contains about twelve stigmata. The transverse vessels are not narrow (Pl. XIV. fig. 18, *tr.*). The stigmata are arranged with great regularity, and are long with rounded ends. The ciliated cells are broad and low,

they are flat-topped and do not project as in the case of *Colella pedunculata* and some other species.

The endostyle is long and narrow, but conspicuous; its course is nearly straight. The languets (Pl. XIV. fig. 19, *l.*) are well developed. The tentacles are very long and thin. Their bases form a rather small circle (Pl. XIV. fig. 20) and are closely placed. There are about two dozen large tentacles and some smaller intermediate ones. The peripharyngeal band is very distinct, it does not form a peritubercular area. The mass formed by the nerve ganglion and neural gland is large and of an elliptical shape (Pl. XIV. fig. 20, *n.g.*). From its anterior end projects a very large and conspicuous neural duct with thick walls, which runs forward under the peripharyngeal band to open in the prebranchial zone, not far behind the base of the tentacles (Pl. XIV. fig. 20, *d.t.*). In all probability this very distinct neural tube really corresponds to the funnel-shaped enlargement, lined by columnar ciliated cells which is found in other forms (see *Botrylloides fulgurale*, Pl. III. fig. 8), and not to the more delicate part of the duct lying behind that.

The alimentary canal is relatively not very large. The œsophagus is a narrow tube which runs from the dorsal edge of the posterior part of the branchial sac backwards and dorsally to open into the irregularly globular stomach (Pl. XIV. fig. 21). The œsophagus does not enter at the anterior end of the stomach, but a little way back on the inner edge. The stomach is thick walled, but has no folds in its interior. At the posterior end of the stomach the intestine commences by a very narrow passage which soon expands into a somewhat quadrate thick-walled dilatation (Pl. XIV. fig. 21); from this cavity the intestine continues backwards as a wide tube which turns round ventrally and then anteriorly to become the rectum. From this point forward the tube contains a series of ovate fæcal pellets of a dark colour, which are just visible to the naked eye (Pl. XIV. fig. 21, *r*). The rectum is very long; it crosses the œsophagus, and is then continued up the dorsal edge of the branchial sac for a very considerable distance. The anus is small but has a prominent margin (Pl. XIV. fig. 21, *a.*).

The reproductive organs are large, and form an ovate mass (Pl. XIV. fig. 22) extending for a considerable distance behind the alimentary canal. They thus agree with the arrangement seen in the other Polyclinidæ, where there is always more or less of a post-abdomen developed, in which the genital glands are situated. In the development of this region of the body the present species is intermediate between *Colella* and the Distomidæ on the one hand, and most of the Polyclinidæ on the other.

The mature Ascidiozooids are hermaphrodite. Ova of various sizes and ages are found along with fully developed spermatic vesicles (Pl. XIV. fig. 22, *o.* and *t.v.*). The ova form a clump upon one side of the genital mass, while the ovate spermatic vesicles are grouped in front and at the sides, and especially behind, where they form the most posterior part of the body of the Ascidiozooid. The vas deferens is large and is always a

conspicuous object (Pl. XIV. fig. 22, *v.d.*). It branches through the genital mass, giving off a twig to each spermatic vesicle, and on leaving the mass at its anterior end attaches itself to the rectum, along which it runs anteriorly to open into the peribranchial cavity.

Tailed larvæ were found in some of the Ascidiozooids; they have ovate bodies with conspicuous sense organs placed far back (Pl. XIV. fig. 23).

Polyclinum depressum, n. sp. (Pl. XXVI. figs. 5–7).

The Colony is an irregularly discoid mass incrusted with stones and shell-fragments. The upper free surface is flattened, while the lower attached part is rather convex. The surface is very irregular, and not smooth. The colour is light grey.

The length of the colony from the base of attachment to the free surface is 1·5 cm., the greatest breadth is 5 cm., and the greatest thickness 4 cm.

The Ascidiozooids are fairly large, but few in number, and very irregularly scattered. They are usually about 5 mm. in antero-posterior length, and are distinctly composed of two parts, the anterior consisting of the thorax and abdomen, and the posterior of the long post-abdomen.

The Test is thick, but soft and gelatinous. It is of a light grey colour and is semi-transparent. The matrix is clear and structureless, and contains numerous test cells, most of which are more or less rounded in form. No bladder cells are present.

The Mantle is strong and opaque. The chief muscle bands run longitudinally and form over the greater part of the body a continuous muscular coating. The musculature on the post-abdomen is especially strong.

The Branchial Sac is of small size. The stigmata are minute and inconspicuous.

The Alimentary Canal is small, and the intestine forms a narrow loop.

The Post-Abdomen is very large. It springs from the ventral edge of the posterior end of the abdomen.

Locality.—Torres Strait, north of Australia; depth, 3 to 11 fathoms.

This species is formed for a flat incrusting colony obtained in Torres Strait, between Australia and New Guinea, from a depth of 3 to 11 fathoms. It has evidently been attached by more than half its surface to small stones, shell-fragments, and other foreign bodies, while a considerable portion of even the upper surface is incrusted with Polyzoa and Zoophytes. Where exposed the surface is irregular and roughened (Pl. XXVI. fig. 5). It does not vary in colour, being a light grey all over. No common cloacal apertures and no systems of Ascidiozooids are visible in any part of the colony.

The Ascidiozooids are of an opaque pale yellow colour, and seem to be placed very irregularly in the test; they lie at all angles to the outer surface. The abdomen is not

distinctly separated from the thorax, but the post-abdomen is conspicuous (Pl. XXVI. figs. 6, 7). The Ascidiozooids are not at all numerous, and some of them seem to be partially decayed. Possibly the colony may have been in a dying condition when it was found.

The test is singularly soft considering its thickness. The test cells are rather large, and they are very abundant. The musculature of the mantle is much stronger than is usual in the Polyclinidæ. The muscle fibres are of large size. The branchial aperture is very distinctly six-lobed (Pl. XXVI. fig. 6), and the atrial aperture is provided with a prominent languet.

The branchial sac is of quadrate form and very opaque. The endostyle is small and inconspicuous.

The abdomen differs somewhat in size in different Ascidiozooids. Figures 6 and 7 on Plate XXVI. show two specimens, in one of which (fig. 6) the intestine reaches much further beyond the branchial sac than it does in the other (fig. 7). The stomach is smooth walled.

The post-abdomen is usually three or four times as long as the combined thorax and abdomen, and about half their breadth. It is sometimes dilated at the end to form a bulb with a small terminal knob (Pl. XXVI. fig. 7). Both ova and spermatic vesicles are found in the same post-abdomen, and the large vas deferens is always a conspicuous object (Pl. XXVI. figs. 6, 7, *v.d.*), running in an irregular and convoluted course along the dorsal edge of the post-abdomen.

Polyclinum molle, n. sp. (Pl. XXV. figs. 7–9).

The Colony is an irregularly rounded mass, somewhat compressed laterally, and attached by the whole of the lower end. The upper surface is wide and convex, the lower is rather narrower and is flattened. The surface is uneven but smooth. The colour is dark grey.

The length is 2·4 cm., the breadth is 3·3 cm., and the thickness 1·5 cm.

The Ascidiozooids are of moderate size and not very numerous. They appear to be placed quite irregularly in the colony, and no systems are present. The body is from 6 to 8 mm. in length and 1·5 mm. in greatest breadth, and the three regions are clearly distinguishable.

The Test is soft and flexible. It is of a dull grey colour and moderately transparent. Large numbers of minute sand-grains are imbedded in it, especially in the outer layers. The test cells are abundant and of all shapes, most of them much branched; some of those in the outer layer are very granular. No bladder cells are present.

The Mantle is thick and opaque, but not very muscular. The chief muscle bands run longitudinally.

The Branchial Sac is not large. Its wall is thick and opaque, and considerably corrugated. The stigmata are small and inconspicuous.

The Alimentary Canal is large and quite opaque. The stomach is globular, and smooth walled.

The Post-Abdomen is moderately long, and very irregular in its thickness. It is separated from the abdomen by a marked constriction.

Locality.—Station 320, February 14, 1876 ; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms ; bottom, green sand ; bottom temperature, 37°·2 F.

One specimen of this species was obtained by the trawl off the east coast of South America at a depth of 600 fathoms. It is a dull grey-coloured soft-looking colony attached by a wide base to a mass of sand and fragments of Polyzoa and other foreign bodies (Pl. XXV. fig. 7). Small dark sand-grains are found scattered all over the upper surface. They add considerably to the darkness and opacity of the test. The bodies of the Ascidiozooids are of a dull yellow colour, and they are only seen indistinctly without dissection (Pl. XXV. fig. 7). No common cloacal apertures are visible.

The test, although it forms a large mass, is soft and is very readily torn, and even the presence of the imbedded sand fails to render it firm. In the outer layer where the test cells are very abundant and most of them fusiform and arranged with their long axes parallel, the matrix is slightly fibrillated. In other parts it is clear and apparently structureless.

The body of the Ascidiozooid is of very irregular form (Pl. XXV. fig. 9). In a specimen 7·5 mm. in length the thorax measured 2·5 mm., the abdomen 2 mm., and the post-abdomen 3 mm. The breadth varies greatly in the different regions. The thorax is nearly cylindrical, but the abdomen and post-abdomen are both irregularly swollen (Pl. XXV. fig. 9, *th.*, *ab.*, *p.ab.*).

The muscle fibres in the mantle are large (Pl. XXV. fig. 9, *th.*), but there are comparatively few in each bundle, and the bundles are not very closely placed. The atrial aperture is provided with a short pointed atrial languet. The branchial aperture is surrounded by six broad low lobes (Pl. XXV. fig. 9, *br.l.*). The sphincter is well developed. In the post-abdomen the muscle bands are feeble but very closely placed, they are all longitudinal in direction.

The transverse vessels of the branchial sac are wide, and have well-marked horizontal membranes (Pl. XXV. fig. 8, *h.m.*). The fine longitudinal vessels are wider than the stigmata. The endostyle is large and conspicuous, its course is undulating (Pl. XXV. fig. 9, *en.*).

The stomach is of large size and almost spherical, it is thick walled but smooth (Pl. XXV. fig. 9, *st.*). The intestine is long, it forms a narrow loop. The alimentary canal is so placed that the stomach lies not only on the ventral side of but anteriorly to a part of the rectum (Pl. XXV. fig. 9, *st.* and *i.*).

The post-abdomen is swollen in its upper part where the reproductive organs are placed, and is very narrow in its lower part (Pl. XXV. fig. 9, *p.ab.*). The edges are much corrugated. The ova are large and opaque. The vas deferens is wide and conspicuous in its whole course (Pl. XXV. fig. 9, *v.d.*). At the posterior extremity of the post-abdomen there are one or two short cæcal projections, resembling rudimentary vascular appendages (Pl. XXV. fig. 9, *v.ap.*).

Fully developed tailed larvæ were found in the peribranchial cavities of several of the Ascidiozooids. The body of the larva is narrow and elongated. There is a single pigmented sense-organ placed rather far back.

Polyclinum incertum, n. sp. (Pl. XXVI. fig. 10).

The Colony is a small irregularly rounded mass attached by one end and sometimes slightly pedunculated. The upper surface is broad and convex. The colour is a dark grey with a slight brownish tinge. The surface is uneven and not smooth.

The length is 1·3 cm., the breadth 1·2 cm., and the thickness 1 cm.

The Ascidiozooids are long and narrow. They may be 6 mm. antero-posteriorly and less than 1 mm. in greatest breadth. Fully half the length of the body is formed by the post-abdomen, but the separation into regions is not distinct superficially. The Ascidiozooids are of an opaque yellowish-brown colour, they are not arranged in systems.

The Test is soft and flexible, it is semi-transparent, and allows the bodies of the Ascidiozooids to show through distinctly. The matrix is clear, but is slightly fibrillated in some parts. The test cells are not very numerous. They are mostly rounded or fusiform in shape. There are no bladder cells.

The Mantle is moderately muscular, most of the muscle bands run longitudinally. The sphincter at the branchial aperture is well developed.

The Branchial Sac is small and its walls are opaque. The stigmata are very minute and inconspicuous.

The Endostyle is wide and has a very undulating course.

The Tentacles are rather long and narrow, and are of different lengths.

The Alimentary Canal is of moderate length, and the stomach is rather large.

The Post-Abdomen is large, and contains both male and female reproductive organs.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

Three small colonies from Station 313 have been placed in this species. They are all different, but may, I think, be conveniently regarded as slight variations of one species. The colony from which the above description and measurements were taken is more

rounded and lighter in colour than the other two. It is attached to sand-grains, &c., by a narrow area at the posterior end. A second colony is much longer but narrower (Pl. XXVI. fig. 10). It is 2 cm. in length, 9 mm. in breadth, and 4 mm. in thickness. It has a long peduncle incrusted with dark coloured sand-grains. The third colony is much smaller, being 9 mm. in length, 8 mm. in breadth, and 5 mm. in thickness. It is darker in colour than the other two colonies. In all the specimens the upper surface where the anterior ends of the Ascidiozooids are placed is lighter in colour and softer than the rest of the colony. The surface is slightly roughened all over, and a few sand-grains are found adhering far above the base of attachment (Pl. XXVI. fig. 10).

The test is soft and is easily deformed, especially on the upper surface of the colony. Lower down the incrusting sand-grains make it stiffer. The dull brown bodies of the Ascidiozooids show through it distinctly on the sides of the colony. They are not so clearly visible on the upper surface.

There is no definite arrangement amongst the Ascidiozooids, but their anterior ends all point towards the upper surface, and their long bodies lie nearly vertically in the colony.

As usual the muscle bands of the mantle almost die away on the abdomen, but become stronger again on the post-abdomen. The branchial aperture is distinctly six-lobed. The branchial sac is very rudimentary, but the endostyle is broad and conspicuous.

The tentacles are exceptionally narrow, and some of them are of considerable length. There is no definite arrangement.

The œsophagus leaves the posterior end of the branchial sac and runs backwards to open into the large ovate stomach. The intestine is narrow; it arises from the posterior end of the stomach and turns almost at once dorsally and then anteriorly, forming a short but rather wide loop. The rectum is large, it runs forwards alongside the stomach, œsophagus, and branchial sac, to open into the peribranchial cavity.

The convoluted vas deferens is a conspicuous object in its entire length, both in the post-abdomen and also in its course alongside the rectum.

There are two or three small irregular projections at the posterior end of the post-abdomen, which look like rudimentary vascular appendages.

Polyclinum minutum, n. sp. (Pl. XXV. figs. 10–12).

The Colony is irregularly rounded in form, and is attached by a small area at one end. There is no lateral compression. The colour is dull yellowish-grey, and the surface is smooth.

The length is 1 cm., the breadth 1·3 cm., and the thickness 1·1 cm.

The Ascidiozooids are very small, about 3 mm. in length and 0·5 mm. in greatest breadth. They are not numerous, and are scattered quite irregularly over the colony.

The Test is very solid, and is nearly quite opaque. The matrix is crowded with test-cells.

The Mantle is thin but fairly muscular. The muscle bands are very delicate, and run mainly in a longitudinal direction. The branchial sphincter is fairly strong.

The Branchial Sac is of moderate size. The transverse vessels are all equally wide. The stigmata are large and well developed. They are wider than the fine longitudinal vessels.

The Dorsal Lamina is represented by languets.

The Alimentary Canal is large. The stomach is very long, and is smooth walled.

Locality.—Royal Sound, Kerguelen Island; depth, 20 to 60 fathoms.

The small colony placed in this species resembles *Amaroucium lævigatum* in its general appearance and in the solidity of the test, but differs from it in several points in the structure of the Ascidiozooids. It is a small nearly globular colony (Pl. XXV. fig. 10), which was obtained at Royal Sound, Kerguelen Island. It is of rather a dark colour, having a distinctly brown tinge, and is nearly opaque, the Ascidiozooids only showing through faintly even where they are close to the surface (Pl. XXV. fig. 10). A good deal of the irregularity of the specimen is due, I believe, to contraction on being put into alcohol; the shape was probably more nearly spherical when living. The Ascidiozooids are placed at various angles to the surface, and their bodies are found traversing the centre of the colony in all directions. The thorax of this species bears considerable resemblance to that of *Distaplia rosea* amongst the Distomidæ.

The test is very stiff and tough, not only on the external surface, but all through. It is very densely crowded with test cells, and these are rather larger than usual, and very granular. This causes the great opacity of the test. There are no bladder-cells and no vessels.

The mantle has a very delicate but fairly abundant musculature. On the post-abdomen the bundles are closely placed. The branchial aperture has six triangular lobes; the atrial aperture is prominent, and has a large rounded atrial languet (this was not visible in the Ascidiozooid figured, Pl. XXV. fig. 11).

The branchial sac is well developed. There are usually seven or eight rows of stigmata. The ciliated cells on the edges of the wide stigmata are large and conspicuous. The transverse vessels are wide and have horizontal membranes (Pl. XXV. fig. 12, *tr.* and *h.m.*). The tentacles are not numerous. The endostyle is conspicuous (Pl. XXV. fig. 11, *en.*).

The alimentary canal forms a long narrow loop (Pl. XXV. fig. 11, *ab.*). The œsophagus is a curved, funnel-shaped tube, which runs from the posterior end of the branchial sac to a point rather on the side of the stomach than at its anterior end. The stomach is very large, and is of an elongated, ovate form, the anterior end being wider

than the posterior, and being perfectly circular (Pl. XXV. fig. 11, *st.*). The stomach is thin walled and has no folds. In this respect it differs from the stomach of *Amaroucium lævigatum*, while in other respects the two alimentary canals are rather similar. The posterior end of the stomach tapers rapidly into the first portion of the intestine, which is a narrow tube running directly backwards. This is separated by a constriction from the second part of the intestine, which is wide and thick walled (Pl. XXV. fig. 11, *i.*) and turns abruptly towards the ventral side, and then anteriorly to open into the rectum. The last portion of the alimentary canal is a long thick-walled tube (Pl. XXV. fig. 11, *r.*) which runs forwards alongside the intestine, stomach, and œsophagus, crossing about the middle of its course so as to reach the dorsal side of the branchial sac. The rectum is much dilated at its commencement, and this part is separated from the intestine by a constriction or short narrow part of the tube.

The post-abdomen is large, and is not separated by any external constriction from the abdomen (Pl. XXV. fig. 11, *p.ab.*). The lower end of the post-abdomen is broad and rounded.

This species and *Amaroucium lævigatum* are certainly allied, notwithstanding their positions in distinct genera.

Aplidium, Savigny.

Aplidium, Savigny, Mémoires, 1816. In part.
Aplidium, Milne-Edwards, Observations, &c., 1842.
Aplidium, Forbes, British Mollusca, vol. i. p. 10, 1853. In part.
Aplidium, Giard, Recherches, &c., p. 635, 1872 (as a subgenus).
Aplidium, Delle Valle, Contribuzioni, &c., p. 34, 1877. In part.
Aplidium, von Drasche, Die Synascidien, p. 25, 1883 (as a subgenus).

Colony massive or lobed, not pedunculated.
Systems compound and irregular.
Ascidiozooids not much elongated; branchial aperture six-lobed, atrial lobed or having a rudimentary languet, and placed far back.
Test gelatinous or cartilaginous.
Branchial Sac fairly well developed.
Alimentary Canal of moderate size. Stomach-wall folded longitudinally.
Post-Abdomen usually short.

This genus, in the restricted sense in which it is now used, was established by Giard, and corresponds only to the first tribe of Savigny's *Aplidium*, a section characterised by the shortness of the post-abdomen. Giard in his classification of the Polyclinidæ used *Aplidium* in two senses:—(1) as a generic term opposed to *Polyclinum*, and including not only all the forms that Savigny included but the genus *Sidnyum* in addition; and

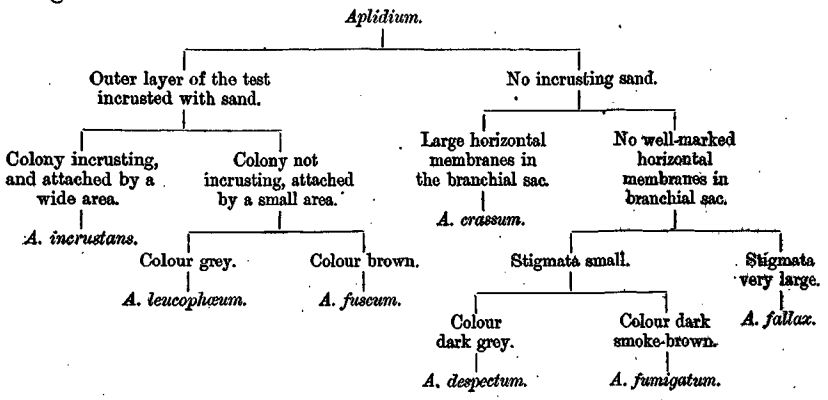
(2) as a subgenus or section of the wider *Aplidium*, and corresponding to the present genus. Giard considered this group of species as characterised by the six-lobed branchial aperture and the short post-abdomen. The first of these characters, however, is shared by nearly all of the Polyclinidæ, and characters derived from the post-abdomen are somewhat unreliable on account of the share which that part of the body takes in gemmation in the Polyclinidæ and its consequent changes in size.

Von Drasche apparently felt this objection, for while he retained Giard's subgenus, he added another character to its diagnosis, viz., that the atrial aperture is placed on the dorsal edge far behind the branchial, and has either no atrial languet or only a very small one. He figures a new species (*Aplidium asperum*, von Drasche) in which this feature is well seen, and seems to regard this amended definition of *Aplidium* as perfectly satisfactory. I am afraid, however, that it is little better than it was before. In the first place the type species of the genus *Amaroucium* (a genus which is most closely allied to *Aplidium*) has the atrial aperture placed far back on the dorsal edge; it is, however, provided with a large languet. And, secondly, the exact position of the atrial aperture varies considerably, not only in the different species of *Aplidium*, but even in the different Ascidiozooids of one colony, and in some cases it is found in an intermediate position which might either be described as dorsal or anterior.

In the Table on p. 152, von Drasche's characteristic has been made use of in distinguishing *Aplidium*, as I believe that it is somewhat more reliable than the length of the post-abdomen, but in any particular case where it failed to indicate the genus, then, on account of the six-lobed branchial aperture, the longitudinally folded stomach and the sessile post-abdomen, *Aplidium* would be thrown (see Table, p. 152) along with *Amaroucium* and *Sigillina*. The extremely long and attenuated post-abdomen of the latter genus, and its distinctly six-lobed atrial aperture, would sufficiently distinguish it from *Aplidium*, and consequently the only risk of confusion would be with *Amaroucium*. After a careful consideration of all the known species of both genera I find that there is no single reliable character which will separate the two groups in all their species. Consequently in such a case it would be necessary to make use of a combination of characters, of which the following are the most important:—

Aplidium.	*Amaroucium.*
Colony not pedunculated, Ascidiozooids not very long, atrial aperture placed dorsally and usually with no atrial languet, post-abdomen shorter than thorax and abdomen.	Colony often pedunculated or elongated vertically, Ascidiozooids long, atrial aperture anterior or slightly dorsal, provided with a large atrial languet, post-abdomen usually long.

The species of *Aplidium* in the Challenger collection may be distinguished by the following characters :—



These species are all new to science with the exception of *Aplidium fallax*, Johnston, a British species.

Aplidium incrustans, n. sp. (Pl. XXVII. figs. 3–8).

The Colony is quite irregular in shape. It is a large expanded incrusting mass attached by the greater part of the lower surface. The upper free surface is convex. The edges are thick and rounded. The colour is a dark dull grey with light grey spots formed by the bodies of the Ascidiozooids. The surface is even and smooth.

The length of the colony is 5·5 cm., the breadth is 3 cm., and the average thickness is about 0·5 cm.

The Ascidiozooids are large, measuring as much as 5 mm. in length. The greatest breadth is about 2 mm. They lie somewhat irregularly, but most of them are more or less at right angles to the upper surface. The part which is visible on the exterior of the colony is rather more than the anterior end, and forms a spot sometimes upwards of 2 mm. in its greatest extent. There is no long post-abdomen, and no vascular appendages are present.

The Test is soft, and tears readily. The external layer is rather firmer than the internal part, and is very smooth and glistening on the surface. Sand-grains are scattered sparsely all through the outer layer. In sections the test is seen to be crowded with cells of very considerable size and of various shapes. The commonest forms are triangular and stellate, with very long branched angles and processes. The nuclei are large and distinct. The matrix is clear and structureless.

The Mantle is fairly strong. The muscle bands are delicate but rather closely placed. They run chiefly in a transverse direction on the thorax.

The Branchial Sac is large and has many stigmata. The transverse vessels are wide and are all of the same size. The stigmata are very long and narrow. They are arranged with regularity.

The Endostyle is conspicuous. It has a very undulating course.

The Dorsal Lamina is composed of long triangular languets with pointed ends.

The Tentacles are large. There are about eight very long and the same number of smaller ones placed alternately.

The Alimentary and Reproductive Viscera are closely placed, and form a large opaque mass tapering towards the posterior end.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2 F.

This species is represented by a large irregularly shaped mass and a few small lumps, all obtained from Station 320, off the east coast of South America, at a depth of 600 fathoms. The large mass, from which the measurements given above are taken, incrusts a fragment of a corallum[1] (Pl. XXVII. fig. 3), while the smaller colonies are attached to pieces of a Polyzoon. The smaller specimens are merely rounded lumps, and they agree in other particulars with the larger colony. The colour is a dark grey, which is produced by the test, while the bodies of the Ascidiozooids show through as patches of a lighter and slightly yellowish grey. No common cloacal apertures are visible, but the surface is not in perfect condition, being torn in places and somewhat distorted.

The Ascidiozooids are scattered apparently quite irregularly, and are fairly numerous (Pl. XXVII. fig. 3). They dip into the mass at various angles and are of different lengths. The anterior part of the body which shows through the transparent upper layer of test is from 1 mm. to 3 mm. in its greatest length.

The test is very soft, and as there is a good deal of it the colony as a whole is soft and easily deformed. It has evidently become considerably flattened and distorted in places from pressing against the sides of the bottle in which it was preserved. The outer layer of the test very readily tears off as a thin membrane; it is perfectly transparent. In this many sand-grains and fragments of sponge spicules and other foreign bodies are imbedded (see Pl. XXVII. fig. 4, where *o.s.* indicates the outer surface), and they are even found more rarely in the deeper layers of the test. The cells are particularly large, and give off very long and much-branched processes (Pl. XXVII. fig. 4, *t.c.*).

The colony is not attached by the entire lower surface. The rounded growing edges, which contain smaller and more regularly arranged Ascidiozooids, project freely and are not attached. The upper central part of the large colony has some of its Ascidio-

[1] Belonging to one of the Stylasteridæ.

zooids partly ejected from the test and in a decomposed condition, while large areas of test occur in which no Ascidiozooids are present. Hence it is probable that this is the oldest part of the colony, and that at the time when the specimen was collected many of the Ascidiozooids in this region had died and were being removed from the colony.

The branchial aperture is distinctly six-lobed, and the sphincter is well developed. Equidistant muscle bands are found running longitudinally in the mantle over the alimentary and reproductive viscera to the posterior end of the body.

The branchial sac is very long. It has in some cases at least fifteen rows of stigmata, with nearly twenty in each row. The stigmata are long and narrow (Pl. XXVII. fig. 5), and the stigmatic cells are convex on their free surfaces (Pl. XXVII. fig. 6) and richly ciliated. The transverse vessels (Pl. XXVII. fig. 5, *tr.*) are exceptionally wide for a Compound Ascidian.

The tentacles are large, and their bases, which are rather swollen, touch one another. The long tentacles are at least twice the size of the smaller intermediate ones (Pl. XXVII. fig. 8, *tn.*, *tn'.*). The dorsal languets are large and numerous. They are of the usual shape (Pl. XXVII. fig. 7, *l.*). The median dorsal line between them is occupied by a strong band of muscle fibres.

The alimentary canal forms a narrow loop, the elongated stomach and intestine lying close together. The wall of the stomach is very much folded, the longitudinal ridges projecting into the interior. The rectum is large, and is always filled with dark coloured faecal matter.

The reproductive organs are of moderate size. They form a mass placed behind the intestinal loop, and continuing the abdomen posteriorly for a short distance, and then ending in a point. Thus no very distinct post-abdomen is formed. In most of the Ascidiozooids examined one or two large ova were found, more or less surrounded by a mass of small, ovate spermatic vesicles of an opaque dull yellow colour. The vas deferens is long and conspicuous. The spermatic vesicles and the vas deferens readily stain deep red with picro-carmine.

This species closely resembles *Polyclinum molle* in the external appearance (compare Pl. XXV. fig. 7, and Pl. XXVII. fig. 3), and also in the structure of the test, but they differ notably in the form of the Ascidiozooids and in the structure of the branchial sacs. In the condition of the post-abdomen the present species shows some resemblance to *Polyclinum fungosum*, but differs from it in the structure of the stomach.

Aplidium fuscum, n. sp. (Pl. XXVIII. figs. 8–10).

The Colony consists of a hemispherical mass, slightly compressed laterally, and attached by a small area in the middle of the lower surface. The upper end is broad

and convex, the lower is smaller and slightly concave. The surface is even, but somewhat roughened all over. The colour is brown.

The length is 1·6 cm., the breadth 2·2 cm., and the thickness 1·7 cm.

The Ascidiozooids are fairly large and numerous. Two or three common cloacal apertures are visible on the upper surface of the colony, but the Ascidiozooids are scattered evenly all over the surface, and do not seem to be arranged in systems. The Ascidiozooids are about 9 mm. in length and 1·5 mm. in greatest breadth. The body is quite opaque, and is not distinctly divided into regions. A slight constriction separates the thorax from the abdomen.

The Test is firm, and the outer layer is stiffened by imbedded sand-grains; it is of a brown colour and nearly opaque. The inner part is of a light grey colour, and is more transparent. The test cells are numerous and generally much branched. No bladder cells are present.

The Mantle is thick and very muscular. Both longitudinal and transverse muscle bands are present, and they are closely placed.

The Branchial Sac is of moderate size. There are more than twelve rows of stigmata, and the transverse vessels are wide and all of the same size. The stigmata are long and narrow and are arranged with regularity.

The Dorsal Lamina is represented by a series of languets.

The Tentacles are numerous and closely placed. They are of two sizes.

The Abdomen is relatively of large size, and is very opaque.

The Post-Abdomen is wide, but not very long.

Locality.—Royal Sound, Kerguelen Island, January 19, 1874; depth, 20 to 60 fathoms.

This species, of which a single colony was obtained in Royal Sound, Kerguelen Island, shows some resemblance to *Morchellium giardi* and *Sidnyum pallidum*, while it is very closely related to *Aplidium leucophæum* (see p. 205). It seems, however, to be a distinct form.

The colony is a rounded mass without a peduncle (Pl. XXVIII. fig. 8), and the surface is slightly but evenly incrusted all over with fine black sand-grains, which make it rough. The colour is a rich brown upon which the anterior ends of the Ascidiozooids stand out as small round yellowish spots, the whole being slightly obscured and darkened by the adhering sand-grains (Pl. XXVIII. fig. 8).

The common cloacal apertures are circular and about 1·5 mm. in diameter. The anterior ends of the Ascidiozooids are remarkably evenly distributed over the convex upper surface of the colony, and no traces of any division into systems, or of regular grouping around the common cloacal apertures, are visible.

The test is stiff and opaque, and the outer layer is particularly hard. The test cells

are of rather large size and of various shapes. In the outer layer they are very numerous and closely placed. The brown colour is probably due to their presence.

The musculature of the mantle is much more developed than is usual in Compound Ascidians. The transverse bands are closely placed, and over part of the thorax they form almost a continuous layer. The longitudinal bands are more distant, but they are strong. The whole arrangement recalls the musculature of some of the Cynthiidæ amongst the Ascidiæ Simplices. Possibly the stiffness of the outer layer of the test has necessitated this excessive development of the muscular system, in order that complete contraction of the Ascidiozooid might be effected.

The branchial aperture is wide, and is surrounded by six slight lobes (Pl. XXVIII. fig. 10, *br.*). There is almost no branchial siphon, and the sphincter muscle is not strong. The atrial aperture is provided with a large bifurcated atrial languet (Pl. XXVIII. fig. 10, *at.*).

The fine longitudinal vessels in the branchial sac are rather wider than the stigmata (Pl. XXVIII. fig. 9, *l.v.*). The transverse vessels have slight horizontal membranes. The branchial region of the body is usually about 3 mm. in antero-posterior extent. The endostyle is large and conspicuous (Pl. XXVIII. fig. 10, *en.*). Its course is undulating.

The alimentary canal is of considerable size and forms a narrow loop. The wall of the stomach is folded longitudinally. The rectum is a long wide thin-walled tube.

Aplidium leucophæum, n. sp. (Pl. XXVIII. figs. 5–7).

The Colony is an irregularly rounded mass, slightly compressed laterally, and attached by a small area at the posterior end. The upper surface is broad and irregularly convex. The lower end is relatively narrow, and the sides slope outwards and upwards. The surface is slightly rough all over. The colour is a dull grey, with pale, circular spots.

The length is 2 cm., the breadth is 2·3 cm., and the thickness is 1·7 cm.

The Ascidiozooids are fairly large and numerous. A single large common cloacal aperture is present in the middle of the upper surface of the colony, but the Ascidiozooids are placed evenly all over the surface, and do not seem to be arranged in systems. The Ascidiozooids are about 1 cm. in length and 1·5 mm. in greatest breadth. The thorax is separated from the abdomen by a marked constriction.

The Test is firm, and the outer layer is stiffened by imbedded sand-grains. It is of a dark grey colour and nearly opaque. The inner part is of a lighter grey colour, and is rather less opaque. The test cells are fairly large and rather numerous, especially in the outer layer. They are of all shapes, and are frequently much branched. No bladder cells are present.

The Mantle is thick and opaque. The musculature is very well developed on the thorax; both transverse and longitudinal bands are present.

The Branchial Sac is fairly large and very well developed. The transverse vessels are rather narrow and all of about the same size. The stigmata are large, numerous, and arranged with regularity.

The Dorsal Lamina is represented by a series of large triangular languets.

The Tentacles are large.

The Alimentary Canal is relatively of large size. It forms a long narrow loop.

The Post-Abdomen is wide but not very long.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

This species is very closely allied to *Aplidium fuscum*, and may indeed turn out to be merely a variety of that species. They were both obtained at Kerguelen Island in comparatively shallow water. The external appearance is very much the same in the two colonies (compare figs. 5 and 8 on Pl. XXVIII.), except that the one is of a brown colour, while the other is dark grey. In both cases the anterior ends of the Ascidiozooids show on the upper surface of the colony as light-coloured areas, and in both minute black sand-grains are found adhering to the surface all over. In the present case the colony is rather more compressed, and the posterior end is narrower than in the former species.

The arrangement of the Ascidiozooids is precisely the same in the two cases, but they seem slightly larger in the present species, and the thorax is much more clearly separated from the abdomen. In some Ascidiozooids the two regions are merely united by a narrow neck, consisting of the œsophagus and rectum, which readily breaks. The thorax is about 3 mm. in length.

The test, although it differs in colour from that of *Aplidium fuscum*, is very similar in structure. The outer layer is rather lighter and less opaque, which is probably due to the test cells in that region being less granular.

The mantle is very muscular. The transverse bands are closely placed, but not quite so much so as in the case of *Aplidium fuscum*. The branchial siphon is very short, and the aperture is surrounded by six slightly marked lobes (Pl. XXVIII. fig. 6).

The branchial sac is a little different from that of *Aplidium fuscum*. The stigmata are rather larger, and the transverse vessels are narrower (Pl. XXVIII. fig. 7, *tr.*). Slightly developed horizontal membranes are present. There is no interruption on the dorsal edge of the sac, as the stigmata extend across from side to side continuously between the languets (Pl. XXVIII. fig. 7). The endostyle is long and rather narrow. Its course is undulating. The dorsal languets are slightly longer than the stigmata. They are flattened antero-posteriorly, and they taper to narrow points (Pl. XXVIII. fig. 7, *l.*).

The œsophagus is rather wide, and runs straight backwards (Pl. XXVIII. fig. 6). The stomach is moderately large, and is ovoid in form, with the narrower end anterior. Its walls are slightly ridged longitudinally. The first part of the intestine is narrow.

It runs posteriorly from the stomach for some distance, and then turns abruptly towards the dorsal edge and anteriorly to become the rectum (Pl. XXVIII. fig. 6). The most posteriorly placed part of the intestine is usually rather swollen. The rectum is a long, wide, thin-walled tube of very unequal calibre. It forms the dorsal part of the abdomen in its entire length.

There is no constriction or external line of demarcation between the abdomen and the post-abdomen (Pl. XXVIII. fig. 6), and these two regions are usually of the same length. The post-abdomen scarcely tapers at all, and its posterior end is broad and rounded. The musculature on the post-abdomen is rather feeble, and is entirely composed of longitudinal bands. In one specimen a clump of immature ova was found in the anterior half of the post-abdomen, but in the other Ascidiozooids examined the reproductive organs were in an undeveloped condition. The vas deferens, usually such a conspicuous organ in Compound Ascidians, was not visible.

Aplidium crassum, n. sp. (Pl. XXV. figs. 15, 16).

The Colony is an irregularly conical mass attached by the base, which is wide and spreading. The upper end is truncated and irregular in shape. The colour is an opaque whitish-grey, becoming slightly hyaline towards the point of attachment. The surface is very uneven but moderately smooth.

The length of the colony is 2 cm. and the greatest breadth (above the base) is 1·5 cm.

The Ascidiozooids are large, but they are rather deeply placed in the colony, and are only visible towards the posterior end. The body is about 7 mm. in length and 1·5 mm. in greatest breadth. The division into regions is not distinct.

The Test is firm and moderately tough. It is of a light grey colour, but is not transparent. The matrix contains a number of small test cells of various sizes and shapes, and also larger ovate or elliptical and very granular cells. Large bladder cells are present in the outer part of the test.

The Mantle is thick and opaque over the branchial region of the body, and the musculature is very powerful. Both transverse and longitudinal muscle bands are present, and they form a continuous muscular layer.

The Branchial Sac is short, but contains a good many rows of stigmata. The transverse vessels are wide and have well-marked horizontal membranes. The stigmata are short and rounded and rather numerous.

The Dorsal Lamina is represented by a series of rather short and broad languets with blunt points.

The Tentacles are large and all of much the same size. There are about twelve.

Locality.—Off Bahia, Brazil, in shallow water.

The single specimen of this species is an irregularly shaped colony rising from a thin extended base, which incrusts and unites a mass of shell fragments and other foreign bodies. The upper part of the colony has the form of an irregular truncated cone (Pl. XXV. fig. 15); there is no lateral flattening. The colony, although of a light colour, is very opaque, the Ascidiozooids being visible only near the base of attachment, where the test is more transparent, and they come nearer to the surface. They show as light yellowish-grey elongated marks upon the semi-transparent hyaline grey test (Pl. XXV. fig. 15). The surface of the colony is very uneven all over, and some of the foreign bodies are imbedded in the test more than half way up from the base.

The Ascidiozooids though large are not very long antero-posteriorly. They are thick and somewhat sausage-shaped (Pl. XXV. fig. 15). The anterior end is narrow and pointed, while the posterior is broad and rounded. The thorax occupies the anterior third or rather less, and is of a pale yellow colour, while the abdomen and post-abdomen have no clear line of demarcation, and are of a darker colour. The whole body is quite opaque. The broadest region is towards the posterior end of the abdomen.

The test is very thick and solid; it is quite opaque in the upper part of the colony, and is only transparent in thin layers in the lower part. The bladder cells are very numerous in some places, and reduce the matrix to a reticulum (Pl. XXV. fig. 16, *bl.*); in other parts they are entirely absent, and the matrix contains test cells of various kinds. Many of these are of regular ovate form and are filled with fine granules. Probably the opacity of the test is due to the presence of these cells. Here and there also groups of small granular cells occur placed close together. They have assumed polygonal forms from mutual pressure just as in the case of the similar cells in *Atopogaster aurantiaca*. Vessels are present in the test, they terminate in elongated ovate bulbs (Pl. XXV. fig. 16, *t.k.*).

The mantle is extraordinarily thick and muscular over the branchial part of the body. There are powerful bundles running both transversely and longitudinally, and forming a continuous muscular coating. This is quite unlike the usual condition in Compound Ascidians, and it recalls the condition of the mantle in typical Cynthiidæ amongst the Simple Ascidians.

The branchial sac is thick-walled and opaque. Its most notable features are the prominent horizontal membranes and the small rounded stigmata.

The dorsal languets are numerous and large. Their edges are richly ciliated, and at the base they become continuous with the horizontal membranes of the transverse vessels. The large tentacles are closely placed, and seem almost to fill up the branchial siphon.

The alimentary canal is wide but not very long. It is of an opaque yellow colour.

The reproductive organs lie in the intestinal loop, and extend beyond it for a short distance forming a small post-abdomen. Both ova and spermatic vesicles are present in

the Ascidiozooid at the same time. The mature ova are large and of a bright yellow colour. The spermatic vesicles are small and ovate or pyriform; they are very numerous. The vas deferens is long and conspicuous, and is coiled spirally throughout its course. No larvæ were found in the Ascidiozooids examined.

Aplidium fallax, Johnston (Pl. XXVIII. figs. 1–4).

Aplidium fallax, Johnston, Mag. Nat. Hist., ser. 1, vol. vii. p. 15, figs. 4–18.
Aplidium fallax, Johnston, Forbes and Hanley, British Mollusca, vol. i. p. 11, Pl. A. fig. 1, 1853.

Two specimens obtained during the cruise of H.M.S. "Porcupine" in the summer of 1869, in Loch Foyle on the north coast of Ireland, from a depth of 10 fathoms, appear to be referable to *Aplidium fallax*, a species described by Johnston in 1834, and figured by Forbes in 1853. Johnston's specimen was from Berwick Bay, deep water, and Forbes' from the Isle of Man.

The two colonies in the "Porcupine" collection are fixed to the same fragment of a Hydroid Zoophyte and are both of much the same size, about 1 cm. in length, 1·5 cm. in breadth, and 1 cm. in thickness (Pl. XXVIII. fig. 1). The general shape is irregularly ovate, the area of attachment being the middle of the lower surface, which is rather small, while the upper surface is larger and gently convex. The whole surface is rather uneven. The colour is a dull grey with pale opaque yellow spots. No common cloacal apertures are visible on either of the colonies.

The Ascidiozooids are fairly large and rather numerous (Pl. XXVIII. fig. 1). They are placed with their long axes perpendicular to the upper surface of the colony, but they are not arranged in regular systems. The body is usually 3 mm. in length and 1·mm. in breadth, and is not distinctly divided into regions externally (Pl. XXVIII. fig. 2). The thorax is longer than the abdomen, and the post-abdomen is usually rather shorter than the abdomen.

The test is moderately firm, but on account of the large number of Ascidiozooids in the colony it never becomes very thick. It is of a dull grey colour and is semi-transparent. It contains abundance of test cells, some of which are of rather large size; their protoplasm is usually granular.

The mantle is not thick, and is transparent. The muscle bands are few in number and rather weak. They mostly run in a longitudinal direction. The branchial siphon is well developed, and its aperture is six-lobed (Pl. XXVIII. fig. 2, *br.*). The atrial aperture is provided with a well-marked atrial languet.

The branchial sac is large and well developed. The transverse vessels are narrow and all of the same size; they are supplied with muscle fibres. The stigmata are rather long (Pl. XXVIII. fig. 3, *sg.*). They are arranged with great regularity, and are of about the same size as the fine longitudinal vessels between them. Near the ventral

and sometimes also the dorsal ends of each row the stigmata rapidly become smaller, leaving the transverse vessels with wide triangular ends (Pl. XXVIII. fig. 3, *sg'*.), as in *Distaplia* (compare Pl. XVIII. fig. 3). The languets along the dorsal line of the sac are large triangular flaps flattened antero-posteriorly (Pl. XXVIII. fig. 4, *l*.). In some cases the stigmata extend in an uninterrupted series across the dorsal line. The endostyle is conspicuous and has an undulating course.

The alimentary canal is rather large, but the loop it forms is remarkably short (Pl. XXVIII. fig. 2, *i*.). The œsophagus leaves the dorsal edge of the posterior end of the branchial sac and runs for a short distance backwards. The stomach lies on the dorsal edge of the abdomen. It is short and wide, and its wall is thrown into a series of longitudinal folds (Pl. XXVIII. fig. 2, *st*.). The intestine, which is wide and thin-walled throughout, leaves the posterior end of the stomach and turns at once ventrally and then anteriorly. On reaching the level of the front of the stomach it crosses to the dorsal edge of the abdomen, passing over the left side of the œsophagus, and then turns anteriorly to become the rather short wide rectum which runs along the dorsal edge of the thorax (Pl. XXVIII. fig. 2, *r*.). The intestinal loop is wide and forms the ventral part of the abdomen. The intestine and rectum are filled with dark coloured fæcal matter in their entire length.

The post-abdomen is short and wide (Pl. XXVIII. fig. 2, *p. ab*.). It contains both male and female reproductive organs, the ova being placed at the anterior end, while the spermatic vesicles occupy the remainder of the region. The mature ova are large and of a bright yellow colour. The vas deferens is usually conspicuous. Some of the Ascidiozooids examined contained several large tailed larvæ in the peribranchial cavity. The body of the larva is of nearly globular form, and has two pigmented sense-organs.

Aplidium despectum, n. sp. (Pl. XXVIII. figs. 11–13).

The Colony is an irregular mass consisting of two rounded pieces connected by a narrow neck. It was attached by a small area at one end. The surface is irregular but fairly smooth. The colour is a pale brownish-grey.

The length is about 2 cm., the greatest breadth 1·3 cm., and the thickness 0·5 cm.

The Ascidiozooids are small, and appear to be placed quite irregularly. No systems and no common cloacal apertures are visible.

The Test is firm and cartilaginous. It is of a dull grey colour and nearly opaque. The clear matrix is crowded with large test cells, mostly of rounded form and with granular contents. Some of them are slightly pigmented. No bladder cells are present.

The Mantle is moderately thick, but not very muscular. It is rather opaque.

The Branchial Sac is small and opaque. The stigmata are minute ovate slits placed rather far apart.

The Post-Abdomen is short and opaque.

Locality.—Station 48, May 8, 1873; lat. 43° 4′ N., long. 64° 5′ W.; depth, 51 fathoms; bottom, rock.

There is only a single specimen (obtained on the Le Have Bank, off Nova Scotia, from a depth of 51 fathoms) of this species in the collection, and I am inclined to think that it is probably a stunted and abnormally shaped colony (Pl. XXVIII. fig. 11). From the small base of attachment it expands upwards to form a rudely pear-shaped mass, slightly flattened laterally, and connected with another mass of somewhat similar shape and about the same size by a narrow bar about 4 mm. in length and 2 mm. in thickness. Possibly the colony was placed in an irregular crevice between stones. The colour is a dirty fawn, upon which the pale brown bodies of the Ascidiozooids are scarcely visible (Pl. XXVIII. fig. 11).

The bodies of the Ascidiozooids are short, and are not distinctly divided into regions. They are usually about 1·5 mm. in length, and are quite opaque. Their anterior ends occupy slight eminences on the surface of the colony, which give it in places a somewhat roughened appearance.

The test is rather remarkable in its minute structure. It is densely crowded with test cells, most of which are of very large size (Pl. XXVIII. fig. 12, *t.c.*). All the usual shapes are present, but circular and ovate forms are the most abundant, and many of them are very regular in their outlines. The opacity of the test is in all probability due to the presence of these cells. In the outer layers of the test a good many small sand-grains and minute fragments of shells, &c., may be found imbedded.

The chief muscle bands in the mantle run longitudinally. There are only a very few muscle fibres in each band. The sphincter at the branchial aperture is rather feeble.

The branchial sac occupies nearly half the length of the body, but it is narrow and in a lowly developed condition, the stigmata being few in number and of small size (Pl. XXVIII. fig. 13). The stigmatic cells are rather conspicuous.

The alimentary canal is not large, and it forms a short loop. The wall of the stomach is folded. The post-abdomen does not extend far beyond the intestinal loop, and is not separated from it by any constriction. The vas deferens is a wide tube, which is conspicuous running along the dorsal edge of the post-abdomen and abdomen.

In one of the Ascidiozooids examined, a single very large tailed larva (about 0·75 mm. in diameter) of nearly globular form was found in the dorsal part of the peribranchial cavity.

Aplidium fumigatum, n. sp. (Pl. XXVI. figs. 8, 9).

The Colony is of ovate or elongated form, and is attached by the narrower end. Several masses may be united by their lower ends or by a short thick stolon. The upper end is broad and rounded, sometimes laterally compressed. The colour is a dull greyish-

brown marked with dark yellow patches which indicate the Ascidiozooids. The surface is uneven but smooth.

The length is 2 cm., the greatest breadth is 1·3 cm., and the thickness is about 7 mm.

The Ascidiozooids are large. They are elongated opaque dull yellow bodies, about 1·5 cm. in extreme length and 1·5 mm. in greatest breadth. They are not divided externally into regions, and are so opaque that nothing of their anatomy can be made out from the exterior.

The Test is cartilaginous and firm, but not tough. It is rather opaque and of a dull greyish-brown colour. The homogeneous matrix is crowded with numerous small cells mostly of rounded forms. No large bladder cells are present.

The Mantle is moderately thick and very opaque. The muscle bands run chiefly in a longitudinal direction and are numerous and of considerable size.

The Branchial Sac is very thick and opaque. The transverse vessels and the fine longitudinal vessels are very wide, the result being that the stigmata are greatly reduced; they are in the form of small rounded or ovate apertures placed far apart.

Localities.—(*a*) Royal Sound, Kerguelen Island, 28 fathoms (two colonies). (*b*) Kerguelen Island, 10 to 100 fathoms (one colony). (*c*) Kerguelen Island, 10 to 60 fathoms (one large colony). (*d*) Zebu, Philippine Islands, the reefs (one colony).

The colour of this species is a characteristic, which serves to distinguish it at a glance from any other Compound Ascidian I have examined. It is a dark greyish-brown or smoke colour, with rounded or elongated dull yellow patches here and there. The specimen from the reefs at Zebu, Philippine Islands, is rather darker, and has the yellow patches less apparent than in the specimens from Kerguelen Island. This difference is due merely to a slightly greater development of pigment in the test, which is thus rendered more opaque. The specimen labelled "Kerguelen, 10 to 100 fathoms," is decidedly greyer than the others, and shows less of a brown tint. The large colony from Kerguelen, 10 to 60 fathoms, has the upper part of a dark smoky-brown colour, while the basal part becomes gradually lighter till it is of a dull grey.

In shape the colony is an ovate or elongated mass attached by the narrower end either directly or by means of a short thick stolon. In the larger colony from Royal Sound, Kerguelen,[1] there are three more or less ovate masses connected by prolongations of their lower ends forming a stolon (Pl. XXVI. fig. 8). This stolon is not so brown as the upper part of the colony. The specimen from Kerguelen, 10 to 100 fathoms, consists of three masses joined together by their lower ends without the intervention of any distinct stolon. The remaining specimen from Royal Sound, Kerguelen, and the one from Zebu, are each formed of a single mass attached by the lower end. The Zebu specimen has a rather more elongated form than any of the others. The large colony

[1] There is a small colony of *Amaroucium variabile* attached to one of the masses of this specimen.

from Kerguelen, 10 to 60 fathoms, consists of four ovate masses united irregularly by thick peduncles. This colony is much larger than any of the others. The unevenness of the surface in some of the specimens is, I believe, the result of unequal contraction at death.

The upper end of the colony is always rounded, and the point of greatest breadth is usually not far from this end (Pl. XXVI. fig. 8). The dimensions given above are taken from one of the medium sized specimens. The largest colony in the collection measures about 9 cm. in length and 4 cm. in greatest breadth. The smallest specimen is 11 mm. in length and 6 mm. in breadth.

The Ascidiozooids are large and not numerous (Pl. XXVI. fig. 8); they are not arranged with any regularity. They lie more or less vertically in the test, and their anterior ends nearly all open upon the convex upper end of the colony. In the specimens from Royal Sound, Kerguelen, and the large colony from Kerguelen, 10 to 60 fathoms, the Ascidiozooids are particularly conspicuous, and form large opaque yellow marks upon the exterior of the colony.

The test is firm to the touch but tears readily. The outer layer is rather harder and tougher than the interior. It is rather opaque, and only allows the Ascidiozooids to show through when they are close to the surface.

There are no bladder cells and apparently no vessels present (Pl. XXVI. fig. 9). The small test cells are of various sizes and shapes, and many of them are darkly pigmented. These pigment cells are rather more numerous in the outer layer of the test and immediately around the bodies of the Ascidiozooids than elsewhere. In some places they lie closely crowded together so as to form groups in which some of the cells have become more or less polygonal from mutual pressure (Pl. XXVI. fig. 9, *t.c'.*).

The mantle is strongly muscular, and both longitudinal and transverse bands are present, although the former are the largest and most numerous. In some places the muscle bands are very wide and are found to branch and anastomose freely. The ectoderm can be stripped off as a distinct membrane from the surface of the mantle. It is formed of rather large polygonal cells.

The branchial sac is in a very rudimentary condition. As the stigmata are few in number and are reduced to small rounded apertures rather irregularly placed, it is impossible to distinguish the usual systems of vessels.

The alimentary canal is short and wide, and of an opaque yellow colour. The reproductive organs are placed close behind the intestinal loop, consequently the post-abdomen is very short. Young and mature ova of various sizes were found in the Ascidiozooids.

The remaining organs of the body were not worked out in detail on account of the unfavourable condition of the specimens for examination. The tissues are all exceedingly opaque, and the Ascidiozooids, especially in their anterior parts, are much contracted.

Amaroucium, Milne-Edwards.

Aplidium, Savigny, Mémoires, 1816. In part.
Amaroucium, Milne-Edwards, Observations, &c. In part.
Amouroucium, Forbes, British Mollusca, vol. i. p. 15, 1853. In part.
Amaroucium, Giard, Recherches, &c., p. 636, 1872 (as a subgenus).
Amaroucium, Della Valle, Contribuzioni, &c., 1877 (as a subgenus).
Amaroucium, von Drasche, Die Synascidien, 1883 (as a subgenus).

Colony massive, sometimes lobed or pedunculated.
Systems compound and irregular.
Ascidiozooids elongated; branchial aperture six-lobed; atrial usually provided with a long languet.
Test gelatinous or cartilaginous.
Branchial Sac moderately developed.
Alimentary Canal of moderate size; stomach-wall folded longitudinally.
Post-Abdomen large.

Savigny, on account of all his material having been preserved in alcohol, erroneously described his genus *Aplidium* as having no common cloacal cavities, and when Milne-Edwards some years later worked at the Compound Ascidians of the Chausey Archipelago and some other parts of the coast of France in a fresh and living condition he found that none of the species he examined belonged to the genus *Aplidium*. All of those which in other respects agreed with that genus differed from Savigny's definition in having common cloacal apertures. Consequently he established for those forms the genus *Amaroucium*, agreeing with *Aplidium* in most respects, but having common cloacal cavities in the systems.

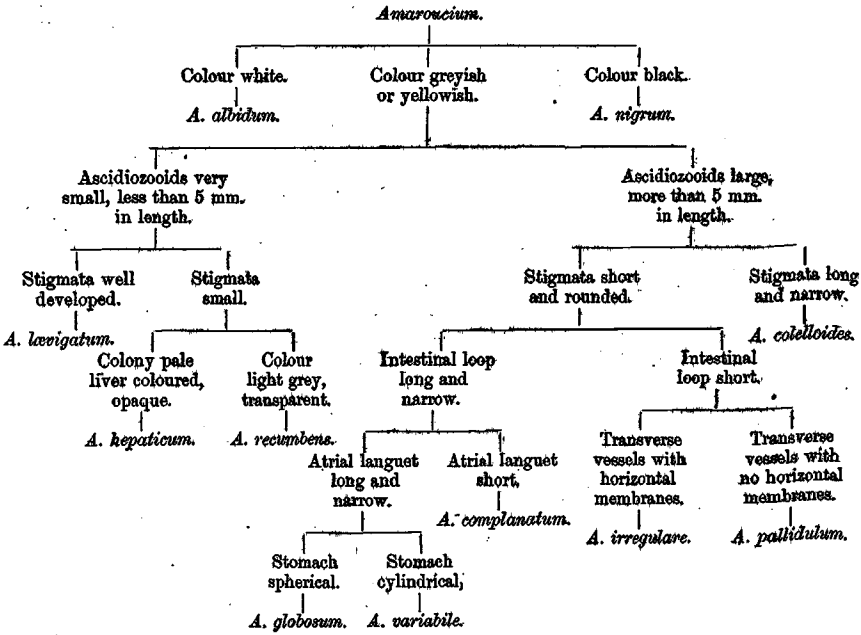
As no species of *Aplidium* in Savigny's sense have since been found in a living condition, it is very probable that, as Giard has suggested, the apparent absence of common cloacal cavities in spirit-specimens is a result of contraction after death, and that Savigny's species of *Aplidium* really had the cavities, and that therefore Milne-Edwards' *Amaroucium* was unnecessary and is merely a synonym of *Aplidium*. Giard, however, in subdividing the Polyclinidæ into genera and subgenera, has retained the name *Amaroucium* for one of the latter. Its characteristics are the long Ascidiozooids, the six-lobed branchial aperture, the anteriorly placed atrial aperture provided with a long atrial languet, the longitudinally folded stomach-wall, and the sessile and greatly elongated post-abdomen; for a discussion of its exact relations to *Aplidium* in the restricted sense, see under that genus, page 200.

Amaroucium is distinguished from *Sigillina*, Savigny, by its unlobed atrial aperture and by the possession of a large atrial languet; while from *Polyclinoides*, von Drasche, it differs mainly in not having any constriction between the abdomen and the post-

abdomen. These are the only genera which are very closely allied to it: the other Polyclinidæ may be all readily distinguished from *Amaroucium* by the characters of the branchial aperture, the structure of the branchial sac, and the condition of the stomach and the test (consult table, p. 152).

This genus is one of the largest in the Polyclinidæ, and contains some of the commonest and most widely distributed forms. In addition to Savigny's and Milne-Edwards' species, others have been described by Olivi, Renier, Della Valle, von Drasche, and others, and now at least eleven new species and several varieties have been added by the Challenger investigations. These new species may be distinguished by means of the table which follows.

It would have been much better in this and all the similar tables if I could have included all the known species of the genus. I have done so wherever it was possible, but in many cases the descriptions of the older species are so short and so imperfect that from the absence of any details of their structure it is quite impossible to include them in the tabular schemes or assign them to their proper positions in the genus.



Amaroucium variabile, n. sp. (Pl. XXIX. figs. 7–12).

The Colony consists of one or more masses of an irregularly ovate or pyriform shape attached by short peduncles. The upper end is broad and generally more or less convex. There may be slight lateral compression. The surface is generally rather uneven and not smooth. The colour is usually yellowish-grey, but may be darker.

The length is 2·5 cm., of which 5 mm. is formed by the peduncle; the greatest breadth is 1·7 cm., and the thickness is about 1 cm.

The Ascidiozooids are numerous and of large size. They are distinctly visible on the outside of the colony. They are usually about 6 mm. in antero-posterior length, and are placed with considerable regularity at right angles to the upper surface of the colony. The division of the body into regions is not distinct.

The Test is firm and cartilaginous. It is of a yellowish-grey colour and is semi-transparent. The matrix is clear and structureless, but it is crowded with minute test cells of various shapes. There are no bladder cells, and no vessels are present.

The Mantle is fairly strong. The musculature consists mainly of a series of longitudinally running bands of fibres placed at equal distances.

The Branchial Sac is well developed. The transverse vessels are fairly wide and have muscle fibres. The stigmata are numerous, but small and inconspicuous.

The Alimentary Canal forms a long narrow loop. The stomach is rather cylindrical in shape, and its wall is longitudinally folded.

The Post-Abdomen is usually of large size.

Localities.—(*a*) Kerguelen Island, 10 to 60 fathoms; (*b*) Kerguelen Island, 10 to 100 fathoms; (*c*) Kerguelen Island, 28 fathoms; (*d*) Royal Sound, Kerguelen, January 19, 1874, 20 to 60 fathoms.

I unite under this species a large number of specimens, collected in the neighbourhood of Kerguelen Island, which present great variations in form, size, colour, and some other particulars. They are, however, all closely related to one another, and although it might be possible to break them up into two or three species, I believe that the differences between the extreme forms are sufficiently bridged over by intermediate conditions to warrant one in regarding them as composing a single species only. They form an extremely interesting series on account of the way in which they illustrate individual variation.

The shape may vary from almost spherical through ovate, ellipsoidal, discoid, and pyriform, to fusiform or wedge-shaped or even quite irregularly elongated forms. The woodcuts (fig. 9, *a* to *l*) show a few of the most striking forms assumed by the species. There are upwards of thirty colonies altogether in the collection, and no two of them have the same shape. In most cases the colony consists of one mass only, and is attached by a longer or shorter peduncle (fig. 9, *b*, *c*, *g*); sometimes the peduncle is prolonged

to form a creeping stolon (fig. 9, *a* and *k*), and in one or two cases two masses are attached by peduncles to the same stolon (fig. 9, *l*). One colony from Kerguelen, 10 to 100 fathoms, consisting of two masses, has no peduncle. Two other colonies from the same locality are attached to the long peduncles of *Colella pedunculata*.

The colour varies from light grey through various shades of yellowish-grey to brown.[1] A warm yellow-grey, spotted with opaque light yellow is the most usual colour. The upper surface is generally uneven and rough, but the peduncle is smooth. The smallest colony measures 8 mm. in length and 4 mm. in breadth, the largest (one of the brown variety) is 8 cm. in length and 4·5 cm. in breadth.

The Ascidiozooids are conspicuous. Their anterior ends are all placed upon the upper, usually broad and rounded, end of the colony (Pl. XXIX. fig. 7), and they form circular areas from 0·5 to 1 mm. in diameter, raised slightly above the general surface.

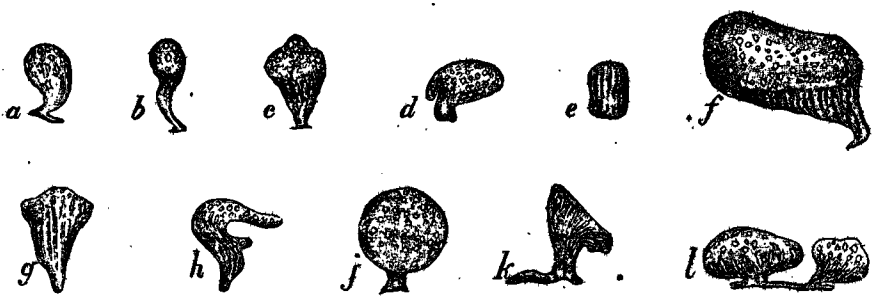


FIG. 9.—*a* to *l*. Eleven colonies of *Amaroucium variabile*, to illustrate the extent of individual variation in this species.

There is usually a common cloacal aperture on the upper end of the colony, and the Ascidiozooids are then arranged in several irregular circles around it. In the larger colonies there are two or three such apertures on the upper surface, but in some of the smaller ones there appear to be no common cloacal cavities present.

The long narrow bodies of the Ascidiozooids are generally visible on the sides of the colony extending downwards towards the peduncle (see fig. 9). The proportions of the body of the Ascidiozooid vary considerably in different colonies, and the difference seems to be due to the size of the post-abdomen. In some cases, although the anterior region of the body is large, the post-abdomen is comparatively short, while in other colonies it is of very great length (Pl. XXIX. fig. 9, *p.abd.*). The Ascidiozooids vary in antero-posterior extent from 3 mm. to 10 mm., and in greatest breadth from 0·5 mm. to 1 mm. The thorax is usually about 1 mm. and the abdomen 1·5 mm. in length.

[1] The darker specimens, of which there are a considerable number, are mostly larger than the others, and might be regarded as forming a distinct variety. They are very variable in shape. Figures 7 and 8 on Plate XXIX. were drawn from one of the brown specimens.

The Ascidiozooids are of a pale yellow colour, and are usually quite opaque. The yellowish tint in the colouring of the colony is due to their presence. The brownish tint in some of the colonies is, on the other hand, caused by the darker colour of the test in these cases, the bodies of the Ascidiozooids showing through as lighter coloured patches on the dark brownish-grey ground.

The small cells in the test vary considerably both in size and shape (Pl. XXIX. fig. 8, *t.c.*). In some places they are aggregated to form small clumps which look like the terminal knobs of vessels; they are, however, merely groups of closely-placed test cells. Many of the cells have granular contents, but no regular pigment corpuscles were noticed except in the case of the brown coloured specimens, where they are abundant. These pigment cells are circular in form and of small size.

The musculature of the mantle is rather regular. The lobes at the branchial aperture are six in number, in some cases they are very well marked (Pl. XXIX. figs. 9, 10, *br.*). The atrial aperture is provided with a very long narrow atrial languet (Pl. XXIX. figs. 9, 10, *at.l.*), which is directed anteriorly and towards the branchial aperture.

The branchial sac in all the Ascidiozooids was considerably corrugated, but whether this condition is natural, or the result of contraction on being put into alcohol, I am unable to say. There are a good many rows of rather narrow stigmata. The ciliated cells are distinct and have pointed free ends. The endostyle is inconspicuous; its course is undulating.

The alimentary canal is long and narrow (Pl. XXIX. fig. 9). The œsophagus runs straight backwards to open into the rather cylindrical stomach, which lies with its long axis directed antero-posteriorly (Pl. XXIX. fig. 9, *st.*). There are about fourteen well-marked longitudinal folds, which are seen in transverse sections of the abdomen to extend about half-way into the cavity (Pl. XXIX. fig. 12). The intestine extends for a considerable distance behind the stomach, and then turns abruptly to the dorsal edge and then anteriorly, forming a narrow loop. The tube usually becomes slightly enlarged in its most posteriorly placed part before turning forwards (see Pl. XXIX. fig. 9, *i.*). The rectum is long and rather narrow, and in its upper part it is very narrow. It lies alongside the intestine, stomach, and œsophagus, and then courses along the dorsal edge of the branchial sac. It forms the dorsal edge of the thorax and abdomen in their entire length (Pl. XXIX. fig. 9, *r.*).

The post-abdomen is very large, it is usually about twice as long as the thorax and abdomen together, and is nearly as wide as the thorax (Pl. XXIX. fig. 9, *p.abd.*). It is very opaque except along the middle, where there is a narrow clear line formed by the lumen of the double septum. This cavity is clearly visible in transverse sections of the post-abdomen (see Pl. XXIX. fig. 11). There is generally a slight constriction separating the abdomen from the post-abdomen.

In external appearance this species shows some resemblance to *Aplidium fuegiense*,

Cunningham, which was found in the Strait of Magellan during the cruise of H.M.S. "Nassau." That species is, however, described[1] as being of a pale bluish-grey colour, and may possibly be more nearly allied to *Amaroucium complanatum* (see p. 221).

Amaroucium variabile, var. *tenerum*, nov. (Pl. XXIX. fig. 6).

Two of the smaller colonies from Kerguelen Island, 28 fathoms, and three of those from Kerguelen Island, 10 to 60 fathoms, differ considerably from all the other specimens. They are of somewhat elongated form and have no peduncle (see fig. 9, *e*., p. 217). One of the colonies from Kerguelen, 10 to 60 fathoms, consists of three masses (Pl. XXIX. fig. 6). The colour is a pale grey with no yellow tinge, and the surface is smooth.

The Ascidiozooids are rather narrower and more transparent than in the other colonies (Pl. XXIX. fig. 6), and the stomach has the longitudinal folds very slightly marked. In other respects these specimens agree with the description of the species given above. They may be regarded as forming a well-marked variety.

Amaroucium globosum, n. sp. (Pl. XXIX. figs. 1–5).

The Colony consists of a globular mass supported by a very short stout peduncle. There is a distinct constriction at the top of the peduncle, and the lower end is rounded, the area of attachment being very small. The surface is even, but not quite smooth. The colour is a pale yellowish-grey, becoming slightly darker on the peduncle.

The extreme length is 4 cm., of which 1·7 cm. is the peduncle; the greatest breadth is 2·7 cm. and the greatest thickness is 1·8 cm. The thickness of the peduncle is 1·5 cm.

The Ascidiozooids are of moderate size, and are not very numerous. They are arranged in systems of somewhat irregular shape formed by branched lines radiating from the common cloacal apertures, several of which are visible upon the upper surface of the colony. The Ascidiozooids are about 7 mm. in length and 1 mm. in breadth. The body is clearly divided into three regions, of which the post-abdomen is the longest and the abdomen the shortest.

The Test is soft and gelatinous in the upper part of the colony, but much stiffer in the peduncle. The outer layer all over the surface is firmer than the inner part, and may be separated as a distinct membrane. The test is of a light grey colour, and is transparent. The test cells are numerous but small and not pigmented. No bladder cells are present.

The Mantle is thick and opaque. The musculature is not very strong, and the chief muscle bands run longitudinally. The branchial sphincter is well developed.

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 465, 1871; and Notes on Natural History of Strait of Magellan, p. 66, Edinburgh, 1871.

The Branchial Sac is large, and has numerous rows of stigmata placed with great regularity. The stigmata are rather short and rounded.

The Dorsal Lamina is represented by a series of languets.

The Alimentary Canal is of moderate length. The stomach is short and wide, and has a few longitudinal folds.

The Post-Abdomen is long and tapers towards the free end. It contains both male and female reproductive organs at the same time.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

Two specimens in the collection made at Kerguelen Island have been referred to this species, but they differ somewhat in their characters. The description given above is taken from the larger colony (Pl. XXIX. fig. 1). The other differs from it in having almost no peduncle, the globular mass in which the Ascidiozooids are placed being attached by its lower end to a projection composed partly of a prolongation of the test, but mainly of incrusting Sponges and other foreign objects (Pl. XXIX. fig. 2). The test of this colony is exceedingly soft and flexible, and the Ascidiozoods are more numerous than in the larger specimen. The length (exclusive of the prolongation at the base) is 1·6 cm., the breadth is 1·8 cm., and the thickness is 1·3 cm.

In both cases the Ascidiozooids are situated near the base of the globular part of the colony, having apparently been retracted from the upper surface (Pl. XXIX. figs. 1, 2). In both specimens the Ascidiozooids are clearly visible as pale yellow opaque spots upon the clear yellowish-grey test. In the smaller colony (Pl. XXIX. fig. 2) they are rather shorter and broader than the dimensions given in the above description. The arrangement of the Ascidiozooids is the same in both specimens. They are placed vertically in the test, but it is rather difficult to make out the exact shape of the systems. These are not very large, and they are in an intermediate condition between the form found in the genus *Botryllus* and that characteristic of *Botrylloides*. The common cloacal apertures are of small size and are circular in outline.

The test cells are very varied in form, and nearly always have long delicate processes; stellate and branched forms are very common. In addition to the longitudinal muscle bands, the mantle is provided with numerous very delicate fibres which run transversely and obliquely over the thoracic region of the body. The longitudinal bands are numerous and very regularly placed on the post-abdomen. The atrial aperture is provided with a narrow tapering atrial languet which varies considerably in size in different Ascidiozooids. It is often much longer than is shown in the figure (Pl. XXIX. fig. 4, *at.l.*), and in one case was found to be bifurcated, each half tapering to a pointed apex.

The branchial sac is generally about 1·5 mm. to 2 mm. in length and 1 mm. in breadth. The numerous transverse vessels are all of the same size, and are prolonged

inwards to form slight horizontal membranes projecting between the rows of stigmata (Pl. XXIX. fig. 3, *h.m.*).

The endostyle is large and conspicuous (Pl. XXIX. fig. 4, *en.*). Its course is very undulating. The dorsal languets are large and closely placed.

The œsophagus is a long narrow curved tube with the convexity dorsal (Pl. XXIX. fig. 4, *œ.*). The stomach is not large; its shape is almost spherical. The wall is thick, and is folded longitudinally; the folds are especially prominent at the anterior end (Pl. XXIX. fig. 4, *st.*). The intestine is narrow in its first part, which runs posteriorly from the stomach. It usually becomes dilated (see Pl. XXIX. fig. 4, *i.*) just at its most posterior part before turning ventrally and anteriorly to pass into the rectum; the intestinal loop is narrow. The rectum is a long wide thin-walled tube running up the ventral edge of the abdomen and thorax (Pl. XXIX. fig. 4, *r.*). It is usually filled with dark-coloured fæcal matter, and is just visible to the unaided eye in making a dissection of the colony.

The post-abdomen (Pl. XXIX. fig. 4, *p.abd.*) has its edges very irregular, and usually sacculated in appearance. The spermatic vesicles are spherical in shape, and have each a fine duct which runs to the lower end of the vas deferens (Pl. XXIX. figs. 4 and 5, *t.v.* and *v.d.*). They stain a deep red colour with picrocarmine. The vas deferens is large and conspicuous, and of great length. The ducts from the vesicles are all attached along one side of it (Pl. XXIX. fig. 5). The ova are of a bright yellow colour. They are placed in the anterior part of the post-abdomen.

The lower end of the post-abdomen is usually somewhat swollen (Pl. XXIX. fig. 4, *v.ap'*), and it gives off two or three very short cæcal processes which are evidently rudimentary vascular appendages.

Amaroucium complanatum, n. sp. (Pl. XXX. figs. 16–17).

The Colony has the form of an ovate or pyriform mass attached by one end and much compressed laterally. The upper end is broad and rounded, but thin. The surface is rather uneven. The colour is a light grey.

The length is 3 cm., the breadth is 2 cm., and the thickness 5 mm.

The Ascidiozooids are fairly large and numerous. They are greatly elongated antero-posteriorly, and are placed vertically in the colony. The body varies from 5 mm. to 1 cm. in length, and is less than 1 mm. in breadth. It is not divided into regions externally.

The Test is firm and rather tough. It is of a light grey colour and is moderately transparent. The clear matrix is crowded with test cells which are small but very numerous. Most of them are of rounded form, and some are very granular. No pigmented cells and no bladder cells are present.

The Mantle is moderately thick and opaque, but is not very muscular. The muscle bands are all longitudinal in direction.

The Branchial Sac is short, and its wall is thick and rather opaque. The transverse vessels are wide and all of the same size. The stigmata are rather short and rounded. The ciliated cells are distinct.

The Endostyle is conspicuous; its course is undulating.

The Dorsal Lamina is represented by a series of long tapering languets.

The Alimentary Canal is moderately large and forms a long loop.

The Post-Abdomen is very large, and is equally wide all the way down. Its end is broad and rounded.

Locality.—Christmas Harbour, Kerguelen Island, January 29, 1874; depth, 50 to 120 fathoms.

Five colonies of this species were obtained in Christmas Harbour, Kerguelen Island, at depths between 50 and 210 fathoms. They are all of much the same size, the largest being 3 cm. and the smallest 2 cm. in greatest length, but they differ somewhat in shape. Still they are all more or less elongated, have the upper end broad and rounded, and are greatly compressed (Pl. XXX. fig. 16). They look as if they had grown up between stones or in some narrow cleft, which had prevented their expansion laterally. The area of attachment is comparatively small. The colour has in places a pale slaty-blue tint.

The Ascidiozooids are distinctly visible from the outside (Pl. XXX. fig. 16). Their long bodies form opaque grey lines upon the flattened sides of the colony and extend down to the very base. They are of much the same width in all parts, and the post-abdomen is generally longer than the thorax and abdomen together.

The test is rather small in amount, and looks shrivelled and contracted. All the usual shapes of test cells are found, although the majority are ovate or globular. The branchial siphon is rather short, but the sphincter is well developed. The branchial aperture is six-lobed. The atrial aperture is circular, and is provided with a short pointed languet, placed at its anterior edge.

The branchial sac is usually considerably corrugated. The stigmata are small and closely placed. The transverse vessels have well-marked horizontal membranes (Pl. XXX. fig. 17, *h.m.*). The tentacles are numerous and rather short. The nerve-ganglion is large. It is circular in outline. The dorsal languets are very large.

The stomach is short but wide. Its wall is thrown into a series of well-marked longitudinal folds. The rectum is large. The intestinal loop is rather narrow.

The post-abdomen is as wide as the thorax. It varies greatly in length in the different Ascidiozooids. It is of a greyish-yellow colour, and is quite opaque, with the exception of a narrow undulating central clear streak which represents the lumen of

the double median septum. The reproductive organs were in an undeveloped condition in all the Ascidiozooids examined.

This species is closely allied to *Amaroucium variabile*, which was also obtained at Kerguelen Island, but the Ascidiozooids of the two species differ in the shape of the atrial languet and the stomach, and in some other details. Cunningham's *Aplidium fuegiense*, from the Strait of Magellan,[1] is also allied to, and may possibly turn out to be identical with, the present species. On account of the insufficiency of the description it is, however, impossible to determine with certainty even the genus to which *Aplidium fuegiense* belongs. A re-examination of the species is much to be desired.

Amaroucium irregulare, n. sp. (Pl. XXX. figs. 1–7).

The Colony is an irregular mass of very variable shape, but always compressed laterally. The place of attachment at the lower end may be very small or it may be as large as the rest of the colony. The upper end is usually broad and slightly convex, but may be elongated and pointed. The colour is light grey with a slight yellowish tinge. The surface is uneven but moderately smooth except at the lower end, where there is a great deal of imbedded and incrusting sand.

The length is about 3 cm., the breadth about 5 cm., and the thickness about 1 cm.

The Ascidiozooids are of moderate size and are rather numerous. They are about 6 mm. in antero-posterior length and scarcely 1 mm. across the widest part. The body is very opaque, and the division into regions is not very clearly marked. The Ascidiozooids are not arranged in systems.

The Test is soft and gelatinous. The outer layer forms a slightly firmer membrane, which is smooth and glistening. The posterior end is stiffened by imbedded sand-grains. The test cells are numerous and of various shapes, but usually more or less fusiform. There are no bladder cells present.

The Mantle is of moderate strength; the muscle bands are feeble but fairly numerous; they are nearly all longitudinal.

The Branchial Sac is small and rather opaque. The stigmata are short, and the transverse vessels are provided with slight horizontal membranes.

The Dorsal Lamina is represented by a series of short stout languets.

The Tentacles are numerous and rather large.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

This species is probably present in considerable abundance in the Straits of Magellan, as there are more than a dozen specimens in the collection. The form is apparently very

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 465, 1871.

variable. The typical condition seems to be a flattened cake-like mass attached by one end (Pl. XXX. fig. 1). In one case, however, it is attached by one of the flattened sides, so that the compression is from above downwards and not laterally. In other cases the shape is quite different and is very irregular, being either a lobed mass or having an elongated bent form somewhat like that characteristic of *Atopogaster elongata* (compare Pl. XXIV. fig. 3, and Pl. XXX. fig. 2).

In all cases there is an area of attachment at one end, marked by the presence of sand-grains and small stones. This region may be very small (a few millimetres across) or of considerable size (Pl. XXX. fig. 1), up to 7 cm. in length by 3 cm. in breadth; but scattered sand-grains are frequently found attached to the test even on the upper surface of the colony. The colour is a very light grey with a yellowish tint caused by the bodies of the Ascidiozooids showing through the semi-transparent test. The lower end of the colony is always of a dark colour on account of the adhering sand (Pl. XXX. fig. 1). A few of the more irregularly shaped colonies (Pl. XXX. fig. 2) have decidedly more of a yellow colour than the others, and at first I was inclined to separate these forms as a variety, but finally decided not to do so, as they seem to agree with the other specimens in all other respects. One or two of the more remarkably shaped colonies have probably been deformed from growing in chinks between stones, or in some such places where they had not room to expand in all directions.

The measurements given above are those of an average specimen. The smallest colony is 1·4 cm. in length and 1 cm. in breadth. The longest measures 9 cm., and the greatest breadth attained is nearly 7 cm.

The Ascidiozooids are placed in the test with great irregularity, and incline at various angles to the surface. The thorax and the post-abdomen are rather long (see Pl. XXX. fig. 3, *th.* and *p.abd.*), while the abdomen between is very short. The Ascidiozooids are not arranged in distinct systems, and the common cloacal apertures are not visible.

The test is softer and more pliable than in most allied forms. It becomes brittle, however, at the lower end of the colony, where there is much sand imbedded in it. In some of the colonies the smooth membrane formed by the outer layer of the test is much more distinct than in others. I am inclined to think that the specimens of a greyer colour, with fewer and larger Ascidiozooids and a distinct smooth membrane over the outer surface, are old colonies; while those with a yellowish colour, numerous Ascidiozooids, and no distinct outer layer on the test, are younger, although they may be of large size. The test cells are especially numerous in the layers of test immediately around the bodies of the Ascidiozooids. The matrix is exceedingly clear and transparent in thin sections, and shows no fibrillation. There are no vessels present, but occasionally the tip or extreme posterior end of the post-abdomen is seen cut in section in the test, and then looks exactly like the transverse section of a vessel. In some

parts of the test, near the outer surface, there are some rather larger elliptical cells with very granular protoplasm.

The musculature is most strongly developed on the thorax and on the post-abdomen; the abdomen has only a few delicate longitudinal bands. There are six well-marked lobes on the branchial siphon, and a long pointed languet is present at the atrial aperture (Pl. XXX. fig. 3, *at. l.*).

The stigmata vary in size in different branchial sacs. In many cases they are shorter and less numerous than in the piece figured (Pl. XXX. fig. 4, *sg.*).

The alimentary canal is of relatively small size (Pl. XXX. fig. 3, *abd.*, and fig. 6). The œsophagus is a narrow tube which runs directly backwards from the posterior end of the branchial sac to open into the large globular stomach (Pl. XXX. figs. 5, 6, *st.*). The wall of the stomach is thrown into a number of longitudinal folds, usually five on each side, which are clearly visible on the outer surface (Pl. XXX. figs. 5, 6, *st.*), and are seen in a transverse section (see Pl. XXX. fig. 7, *st.*) to be of considerable size. The posterior end of the stomach is slightly narrower than the anterior, and it is continued into the narrow intestine, which runs backwards for some distance in a slightly undulating course (Pl. XXX. fig. 6, *i.*). It then turns dorsally and anteriorly and passes into the rectum, a thin-walled tube of considerable size which runs anteriorly along the dorsal edge of the stomach, œsophagus, and branchial sac, and finally terminates in the peribranchial cavity. The rectum has its wall folded longitudinally in two or three places (Pl. XXX. fig. 7, *r.*), but these folds are neither so large nor so regular as those of the stomach.

The post-abdomen is large and has a small knob at its posterior end like that found in *Atopogaster elongata* (see Pl. XXIV. fig. 4, and Pl. XXX. fig. 3). The heart is placed at the end of the post-abdomen. The usual double membranous septum runs along the whole length (Pl. XXX. fig. 3, *p.abd.*), and separates two cavities in which the reproductive organs are situated.

Amaroucium irregulare, var. *concinnum*, nov. (Pl. XXX. fig. 8).

One specimen, from Station 313, differs in some respects from the other colonies of *Amaroucium irregulare* from that locality, and may consequently be recognised as a variety. It is of elliptical form (Pl. XXX. fig. 8) and is much compressed laterally. It is attached by a very small area at one of the ends, and measures 5·3 cm. in length, 3·5 cm. in breadth, and 1 cm. in thickness. It is slightly paler in colour than most of the other specimens, and has almost no sand attached to the test. The most notable feature in it, however, is that in one region, on one of the flattened sides and especially near the upper end, the Ascidiozooids are arranged in distinct circular or ovate systems like those of a *Botryllus*. There are about a dozen of these systems distinctly visible and clearly

defined (Pl. XXX. fig. 8), while others in the neighbourhood are less definite. In other parts of the colony the Ascidiozooids are apparently placed quite irregularly, as in the other specimens of the species (see Pl. XXX. figs. 1, 2). Here, as in so many other cases, it is impossible from want of material to decide whether it is most convenient to regard this form as merely an individual variation, or as a specimen of a distinct variety worthy of being named.

Amaroucium pallidulum, n. sp. (Pl. XXX. figs. 9–11).

The Colony has the form of a rudely hemispherical mass, attached by about half of the flattened lower surface, and irregularly convex above. There is slight lateral compression, and the edges are all rounded. The colour is light grey, with pale yellow patches here and there where the Ascidiozooids show through the test. The surface is uneven, and is finely roughened all over.

The length (from the base upwards) is 1·5 cm., the breadth is 3 cm., and the thickness is 2 cm.

The Ascidiozooids are fairly large and not very numerous. An average size is about 8 mm. in antero-posterior length and 1·5 to 2 mm. in greatest breadth. The body is not distinctly divided into regions, and the post-abdomen is thick. The whole body of the Ascidiozooid is of an opaque, pale, whitish-yellow colour. There is no arrangement in systems.

The Test is firm and tough. It is of a light grey colour and rather transparent. The test cells are very minute and not very numerous; there are no bladder cells present.

The Mantle is well developed and strongly muscular. Most of the muscle bands run longitudinally.

The Branchial Sac is thick-walled and opaque. The stigmata are small and rounded, and the transverse vessels are all of the same size.

The Endostyle is broad and conspicuous, and has an undulating course.

The Tentacles are numerous and closely placed. They are of two sizes, placed alternately.

The Dorsal Tubercle has a plain circular aperture, and is placed close to the peripharyngeal band.

Locality.—Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 12 fathoms; bottom, sand and gravel.

The single specimen of this species in the collection, is a small irregularly rounded massive colony obtained at Port William, in the Falkland Islands, from a depth of 5 to 10 fathoms. It was attached by a part only of the lower surface, the edge all round being

a free rounded projection (Pl. XXX. fig. 9). The upper surface was probably more perfectly convex in the living condition than it is now.

The Ascidiozooids modify the colour of the colony considerably, on account of their size and the transparency of the test. They are scattered irregularly over the colony, and lie at various angles to the upper surface. The anterior part of the body is of considerable breadth, but there is no external line of demarcation between the thorax and the abdomen.

The test is very compact, and is cartilaginous in consistence; it appears perfectly clear and homogeneous in sections. The test cells are much more numerous in some places than in others. Many of them are fusiform and very much elongated.

Some parts of the mantle are very strong, the musculature forming almost a continuous layer. The sphincter at the branchial aperture is strong.

The branchial sac is very opaque, and is in a lowly developed condition, the stigmata being small and the ciliated cells inconspicuous. The transverse vessels are provided with horizontal membranes (Pl. XXX. fig. 10, *h.m.*). The endostyle is larger and more conspicuous than usual. It occupies a considerable part of the ventral half of the thorax.

The tentacles are stout but not very long. There are about twenty, ten longer and ten shorter. The dorsal tubercle is rather large. The nerve ganglion, which is placed immediately behind the dorsal tubercle, is very large, and is nearly circular in outline.

The abdominal part of the body is relatively small, and the alimentary canal forms a short loop. The stomach has its wall folded longitudinally. The reproductive organs occupy the large post-abdomen. The vas deferens is very wide and is a conspicuous object in its entire length.

In some of the Ascidiozooids tailed larvæ were found. They are large, have a moderately elongated body, with very distinct pigmented sense-organs placed about two-thirds of the way back. The anterior end is rather broader than the posterior (Pl. XXX. fig. 11).

Amaroucium recumbens, n. sp. (Pl. XXIX. figs. 13–15).

The Colony is of slightly elongated form and is attached by the whole of one side to a fragment of shell. The upper one-third is wider than the lower part, and the top is rounded. The lower end is prolonged on one side to form a thin expansion attached to the shell. The surface is moderately smooth. The colour is light grey, becoming rather darker towards the lower end.

The length is 2·5 cm., the greatest breadth is 1·2 cm., the breadth of the lower narrower part is 6 mm., and the greatest thickness is 8 mm.

The Ascidiozooids are rather small, and are not numerous. They seem to be scattered irregularly over the upper part of the colony. The usual length is about 4 mm. and the greatest breadth is less than 1 mm. The thorax is relatively large, being

about 2 mm. in length and considerably wider than either the abdomen or the post-abdomen.

The Test is soft and gelatinous, especially on the upper wide part of the colony. It is of a light grey colour and is transparent. The matrix is crowded with small test cells. No bladder cells are present.

The Mantle is moderately strong. The muscle fibres are few in number but of large size.

The Branchial Sac is large and well developed. There are a large number of transverse vessels. The stigmata are small but numerous. They are narrow with rounded ends.

The Dorsal Lamina is represented by a series of tentacular languets.

The Dorsal Tubercle has a small rounded aperture which leads into a fusiform cavity lying below the nerve ganglion.

The Alimentary Canal is relatively of small size.

The Post-Abdomen is narrow but of moderate length. It is very opaque except in the middle line where there is a clear undulating streak representing the lumen of the septum.

Locality.—Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46° F.

This species is formed for a single colony obtained at the western end of the Strait of Magellan from the considerable depth of 245 fathoms. It is allied to *Amaroucium variabile* and to some other species which were found at Kerguelen Island, but in much shallower water.

The colony is somewhat club-shaped in form, but in place of standing erect and being attached by the base of the peduncle, it is recumbent, and is fixed to a broken shell by nearly the whole extent of one side (Pl. XXIX. fig. 13). There is slight lateral compression, the upper and lower sides, as the specimen lies, being flattened.

The Ascidiozooids are very distinctly visible. In the upper part of the colony there are a few entire Ascidiozooids, while in the lower stalk-like part there are a large number of detached post-abdomens (Pl. XXIX. fig. 13). These last are of an opaque dull yellowish-brown colour, and so give a darker tint to the lower part of the colony.

The test is soft and transparent, and on the top of the colony has an irregular and somewhat ragged appearance (Pl. XXIX. fig. 13). I think it is very probable that when the colony was collected, a number of the Ascidiozooids had recently died and been ejected from the test. Many of the small test cells are very much branched and prolonged into delicate tapering processes.

The sphincter at the branchial siphon is feeble, and the branchial aperture is distinctly six-lobed. There is an atrial languet present (Pl. XXIX. fig. 15, *at.l.*). The stigmata in the branchial sac are very numerous (Pl. XXIX. figs. 14, 15) and of moderate length.

The transverse vessels are large, and are provided with slight horizontal membranes (Pl. XXIX. fig. 14, *tr.*).

The endostyle is conspicuous; its course is very undulating (Pl. XXIX. fig. 15, *en.*). The nerve ganglion is large and almost globular in form.

The alimentary canal forms a narrow loop. The œsophagus is a slightly curved funnel-shaped tube (Pl. XXIX. fig. 15, *œ.*). The stomach is not large; its anterior end is wider than the posterior, and the wall is folded longitudinally. The intestine extends for a considerable distance behind the stomach (Pl. XXIX. fig. 15, *i.*), and then turns abruptly to the dorsal edge and anteriorly to pass into the long rectum which runs forwards along the dorsal edge of the abdomen and thorax (Pl. XXIX. fig. 15, *r.*).

The post-abdomen is variable in size. Some of those that lie detached in the lower part of the colony (Pl. XXIX. fig. 13) are larger than those forming parts of the Ascidiozooids. Probably the separation of the post-abdomen from the remainder of the body is connected with a process of rejuvenescence in the colony, consisting in the death and expulsion of the older Ascidiozooids and the formation of new ones from the detached post-abdomens. There was, however, no evidence in the colony examined that the latter process had commenced. Kowalevsky has shown that in *Amaroucium proliferum* a process of gemmation, resulting in the formation of new Ascidiozooids in the old colony, takes place by the breaking up of the post-abdomen after its separation from the body of an old Ascidiozooid.

A few large tailed larvæ, with almost globular bodies and two pigmented sense-organs placed close together, were found in the peribranchial cavities of some of the Ascidiozooids.

This is one of those species in which the use of the post-abdomen as a distinguishing feature between *Aplidium* and *Amaroucium* might cause an error in classification. In some of the Ascidiozooids the post-abdomen is shorter than the combined thorax and abdomen, and, therefore, judging from this character alone, the species is an *Aplidium*. The shortness of the post-abdomen, however, is merely the result of gemmation having taken place, and the species really belongs, I consider, not to *Aplidium* but to *Amaroucium* (see p. 200).

Amaroucium hepaticum, n. sp. (Pl. XXV. figs. 13, 14).

The Colony was probably of moderate size and rounded in form. It is of a pale liver-colour, and is smooth externally.

The Ascidiozooids are small, not more than 2 mm. in antero-posterior extent, and very narrow; the body is not distinctly divided into regions.

The Test is rather soft except on the outside of the colony, where it is distinctly firmer and tougher. It is of a pale grey tint internally, and becoming gradually darker, passes into a pale liver-coloured tint in the outer layer. It is almost opaque. The

matrix is homogeneous, and is crowded with small rounded test cells. There are no bladder cells and very few vessels present.

The Mantle is not strong. The muscle bands are mainly longitudinal, and are placed far apart.

The Branchial Sac is small, and contains comparatively few stigmata. The transverse vessels are wide and have no horizontal membranes. The stigmata are small round openings regularly placed.

Locality.—Unknown.

This species, like *Atopogaster informis*, is founded upon a fragment of a colony, preserved in absolute alcohol, which is unlike any other specimen in the collection, and is not labelled with any locality or date.

It is a slice measuring about 4·5 cm. in greatest length, 2 cm. in greatest breadth, and 1 cm. in greatest thickness, and has been probably cut from a colony of rounded form at least 5 cm. in height and 4 cm. in breadth.

The small Ascidiozooids are irregularly scattered through a zone of test about 1 cm. in width forming the outer layer of the colony (Pl. XXV. fig. 13). This outer layer of test is of a pale liver-colour, and the contained Ascidiozooids are opaque yellowish-brown. The Ascidiozooids do not show through, as the surface layer of test is almost opaque, consequently they do not affect the colour of the outside of the colony. The central mass of test, in which there are no Ascidiozooids (Pl. XXV. fig. 13), is of a lighter colour, being dull yellowish-grey.

The minute rounded cells in the test are exceedingly abundant, and the dark colour and opacity of the outer layers are undoubtedly due to their presence.

The whole body of the small Ascidiozooid is quite opaque (Pl. XXV. fig. 13) although the mantle is by no means very thick. The branchial sac is in a low state of development (Pl. XXV. fig. 14), and resembles closely the condition of the smallest sacs of *Atopogaster informis* (compare Pl. XXIV. fig. 13, and Pl. XXV. fig. 14).

The alimentary canal forms a comparatively short loop and is quite opaque. The reproductive organs extend for a variable distance behind the intestinal loop, and in some cases form a comparatively long narrow post-abdomen. In sections through the colony the post-abdomen is seen to be occupied by numbers of mesoderm cells placed on both sides of a double median membranous septum.

Although this species may resemble *Atopogaster informis* so distinctly in the structure of the branchial sac, still they are not at all closely allied. They differ greatly in the size of the Ascidiozooids, the condition of the test, and in various other details of structure described above.

Amaroucium lævigatum, n. sp. (Pl. XXX. figs. 12–15).

The Colony is of an irregular ellipsoidal form and is unattached. All its surfaces are rounded, and there is slight lateral compression. The colour is pale dull yellow. The surface is even and is fairly smooth all over.

The length is 3 cm., the breadth 2 cm., and the greatest thickness 1·8 cm.

The Ascidiozooids are very small and rather numerous. They are narrow, and the post-abdomen is elongated to form a narrow filament running towards the centre of the colony. The arrangement of the Ascidiozooids is irregular.

The Test is firm and solid and almost perfectly opaque. The matrix is clear and homogeneous, but it is crowded with test cells of various sizes and shapes. Many of them are of rounded form and rather large size, and are darkly coloured, others are smaller and are elongated and fusiform. There are no bladder cells.

The Mantle is moderately strong. The muscle bands are not numerous, and they run mainly in a longitudinal direction. They are distant on the thorax and feebly developed on the abdomen, but become more closely placed on the post-abdomen. The branchial aperture is six-lobed.

The Branchial Sac is long and narrow. The transverse vessels are rather wide and are all of one size. The stigmata are well developed and numerous. They vary somewhat in size.

The Tentacles are large, and are all of about the same size.

The Alimentary Canal forms a long narrow loop. The stomach is small, but has its wall folded longitudinally.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

The single specimen of this species was obtained at the eastern end of the Strait of Magellan, from a depth of 55 fathoms. It is a small compact colony which apparently was not attached by any part of its surface (Pl. XXX. fig. 12). Ascidiozooids are seen all over the colony, which probably lay on the sand, since dark sand-grains are found imbedded in the test at one of the ends (Pl. XXX. fig. 12). In cross section the shape of the specimen is triangular, with rounded angles and depressions on the sides. These depressions, however, are possibly the result of contraction on being put into alcohol. The colour is more of a pale yellow than a grey. At one end it is darker on account of the imbedded sand-grains.

The anterior ends of the Ascidiozooids may be seen all over the surface as very faint pale yellow spots (Pl. XXX. fig. 12). Nothing further can be made out on account of the opacity of the test. In some places the Ascidiozooids seem to be arranged in small circular systems, but elsewhere they are scattered quite irregularly.

The test is cartilaginous in consistence, and is hard and firm throughout the whole

colony. It is traversed in all directions by the long narrow Ascidiozooids which run irregularly from the surface towards the centre. The test cells are exceedingly numerous and closely placed (Pl. XXX. fig. 15, *t.c.*), and are very diverse in shape and size. The opacity of the test is in all probability due to their abundance. In some places they occur in rounded masses in which the individual cells have become more or less polygonal from mutual pressure (Pl. XXX. fig. 15, *t.c'.*). Although the body of the Ascidiozooid is opaque, the mantle is not thickened, and the musculature is not very strong. The branchial sphincter is feebly developed.

The branchial sac is usually much longer than it is broad (Pl. XXX. fig. 13), but it is small compared with the size of the body. In some cases the sac is about four times as long as it is broad, and there may be fourteen or fifteen rows of stigmata. The stigmata are distinct, but not large (Pl. XXX. fig. 14, *sg.*); they are closely placed and have well-developed ciliated cells. The endostyle is conspicuous. Its course is undulating (Pl. XXX. fig. 13, *en.*).

The alimentary canal is long and narrow. It is usually of about the same length as the branchial sac, consequently the thorax and abdomen are nearly equal in size (Pl. XXX. fig. 13). The œsophagus is a long narrow tube; it starts from the posterior end of the branchial sac, and runs directly backwards to the stomach, which is placed about the middle of the abdomen. The stomach is small and has a globular or a pyriform shape (Pl. XXX. fig. 13, *st.*). Its wall is thrown into from four to six well-marked longitudinal folds. The intestine is very long and is divided into several distinct regions. It leads backwards from the stomach as a narrow tube which runs nearly to the posterior end of the abdomen, and then opens into a short thick-walled pyriform cavity which bends ventrally and becomes continuous with a short and very narrow thin-walled tube which turns anteriorly and opens into the much wider rectum. This last region may be of great length (Pl. XXX. fig. 13, *r.*). It runs anteriorly in a slightly undulating course alongside the intestine, stomach, and œsophagus, and then courses along the dorsal edge of the branchial sac, so as to reach the atrial part of the peribranchial cavity. Consequently there may be as many as four distinct regions in the intestine:—(1) the narrow piece stretching backwards from the stomach, (2) the short wide region, (3) the thin connecting tube, and (4) the long and rather wide rectum. The third portion was not distinctly marked in the Ascidiozooid figured (Pl. XXX. fig. 13).

The post-abdomen is very long, sometimes several times as long as the rest of the body (Pl. XXX. fig. 13, *p.abd.*). It contains both male and female reproductive organs, and ends posteriorly in an irregularly rounded bulb.

In some respects the external appearance of this species suggests *Atopogaster elongata* (see Pl. XXIV. figs. 1–3), which was found in abundance at the same locality, Station 313, but the Ascidiozooids are much smaller and less conspicuous in the present species, besides which there are many of the internal details of structure in which the two forms differ.

Amaroucium colelloides, n. sp. (Pl. XXVII. figs. 9–12).

The Colony is an elongated pyriform body consisting of an irregularly ovate head, and part of a short thick peduncle. The top forms a blunted point, the sides are not flattened, and the base passes gradually into the peduncle. The colour is a dull grey, spotted with lighter grey marks caused by the bodies of the Ascidiozooids. The peduncle is darker in colour on account of adhering sand-grains. The surface is uneven and not very smooth.

The length of the head is 2·2 cm., the greatest thickness is 1·2 cm., and the thickness of the peduncle is 0·9 cm.

The Ascidiozooids are of moderate size, and consist each of an anterior part about 2 mm. in antero-posterior length and nearly 1 mm. in greatest breadth, and which consists of the branchial sac and the alimentary canal, and a posterior part, the post-abdomen, which is very long and narrow and may be traced downwards into the peduncle.

The Test is moderately firm, and is not very transparent. It is of a dull grey colour, and is formed of a homogeneous matrix in which are scattered the usual small cells of various shapes. No bladder cells are present.

The Mantle is not very strong. The muscle bands are thin and are placed rather far apart.

The Branchial Sac is small. The transverse vessels are rather wide, and are all of the same size. The stigmata are moderately long and narrow.

The Endostyle is conspicuous and has a very undulating course.

The Reproductive Organs are placed in a very long and narrow post-abdomen. They are hermaphrodite.

Locality.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 13° 37′ W.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47° F.

There is only one specimen of this species in the collection. It was obtained south of the Cape of Good Hope, from a depth of 150 fathoms. In external form (Pl. XXVII. fig. 9) the colony is like some of the species of *Colella*, but in its structure it is clearly one of the Polyclinidæ. The peduncle has been broken across about 8 mm. below the base of the head, but probably it was not very much longer, as the sandy condition of what remains suggests that it was situated not far from the point of attachment of the colony (Pl. XXVII. fig. 9).

The head is long and narrows considerably towards the upper end. At the base it passes gradually into the relatively thick peduncle, which was probably not more than 2 cm. in length when complete. The peduncle is firm, and is penetrated in all directions by the long narrow posterior prolongations of the Ascidiozooids in the head above. The outer layer of the peduncle has a good deal of sand imbedded in it (Pl. XXVII. fig. 9). This gives it a darker colour than the head.

The test of the head is not soft, but it is not so firm as that of the peduncle. It is of a dark grey colour and is only slightly transparent. The dull yellowish Ascidiozooids show through the superficial layer of test as lighter grey patches with a slight yellowish tinge. No common cloacal apertures are visible in the colony.

The Ascidiozooids are evidently arranged in vertical lines, which are, however, somewhat irregular in parts (Pl. XXVII. fig. 9). Their bodies are not placed at right angles to the surface, but dip inwards at various angles. Consequently in many cases the greater part of the body is visible through the surface layer of test, and measures up to nearly 2 mm. in its greatest extent (*i.e.*, antero-posteriorly). The central region of the head is occupied by the posterior prolongations of the Ascidiozooids, which run chiefly in a longitudinal direction.

The test is fairly tough, and does not show a great many cells in its matrix. The cells are of the usual forms, but are of small size.

The mantle is rather opaque, but is not strongly muscular. Over the post-abdomen it contains a number of longitudinal bands of muscle fibres. The branchial aperture is small, but is distinctly six-lobed. The endostyle is wide, and undulates greatly from side to side in its course. The branchial sac contains few stigmata, but they are of a fair size (Pl. XXVII. fig. 10, *sg.*). The transverse vessels are wide.

The alimentary viscera form an opaque mass placed close against the branchial region of the body and continuous with it; the stomach is folded longitudinally. The reproductive organs are contained in the very long and narrow post-abdomen, upon which they produce a fusiform swelling (Pl. XXVII. fig. 11). They consist of one or two large yellow ova and a number of small spermatic vesicles. The vas deferens is a conspicuous object (Pl. XXVII. fig. 11, *v.d.*). It has a remarkably undulating course.

A considerable number of tailed larvæ are present in the colony. They have the body much elongated antero-posteriorly (Pl. XXVII. fig. 12), and provided with three adhering organs in front which have a somewhat remarkable form. Two pigmented sense-organs are present; they are placed very far posteriorly (Pl. XXVII. fig. 12).

Amaroucium albidum, n. sp. (Pl. XXVI. figs. 11–12).

The Colony is an irregularly elongated mass of considerable size, attached by the lower end, and slightly compressed laterally. The widest part is about the middle, and the upper end is obtusely pointed. The surface is irregular but fairly smooth. The colour is dull white.

The length is 7 cm., the greatest breadth 4 cm., and the greatest thickness 3 cm.

The Ascidiozooids are small and inconspicuous. They are long but narrow, and are very numerous. The thorax and abdomen are short, but the post-abdomen is of great

length. The Ascidiozooids are inclined at various angles to the surface of the colony, and they are not arranged in regular systems.

The Test is hard and cartilaginous, and is quite opaque. It is of a dull whitish colour, with a slight tinge of grey internally. The matrix of the test is structureless or very slightly fibrillated in some places. It contains numerous test cells of various shapes, and a few bladder cells.

The Mantle is moderately strong. The chief muscle bands run longitudinally.

The Branchial Sac is of small size, and is very narrow. The stigmata are small and inconspicuous.

The Alimentary Canal is relatively small, and forms a narrow loop.

The Post-Abdomen is large; it extends for a considerable distance behind the intestinal loop.

Locality.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ W.; depth, 38 fathoms; bottom, sand and shells.

Two large colonies of this species were obtained in Bass' Strait from a depth of 38 to 40 fathoms.[1] They are elongated dirty-white masses with rounded ends, and having no external marks of importance (Pl. XXVI. fig. 11). Both specimens are attached by their lower ends to the insides of Lamellibranch shells.[2] The area of attachment is of moderate size, 2 to 3 cm. across. From the base the colony increases somewhat in size as it is traced upwards, and it becomes slightly flattened. Above the middle it tapers irregularly to the blunted apex.

The dimensions of the second colony are:—length 5·5 cm., breadth near the middle 4·5 cm., thickness near the middle 2 cm. In this specimen the thickness decreases regularly from the base of attachment to the apex. The lower end is partially incrusted with shell fragments, Polyzoa, and other foreign bodies.

The surface is marked in some places with deep grooves and depressions (Pl. XXVI. fig. 11), which may be partly the result of irregular contraction, otherwise it is fairly smooth, but it is not glistening. The colour is dull white on the projecting parts, becoming of a greyish cream-colour in the depressions. No common cloacal apertures and no systems of Ascidiozooids are visible on any part of the colony.

The Ascidiozooids are very narrow, but of considerable length. On cutting open the colony their filiform bodies may be seen penetrating the test in all directions. They are of an opaque dirty-white colour, sometimes with a yellowish tinge, and are very numerous. They probably help in giving the colony its whiteness and opacity, since the test around them is slightly grey in hue, and is not so opaque as the surface of the colony.

The test is very solid and tough, and the outer layer is rather stronger than

[1] That is the depth at the Station, but the parchment label in the bottle is marked 85 fathoms.

[2] A species of *Pectunculus* (?).

the rest. The test cells are fairly large and numerous (Pl. XXVI. fig. 12, *t.c.*); triangular and stellate forms with very long rays are the most common, but rounded granular ones are also present. The bladder cells are not numerous, and they are rather small.

The mantle is strong and opaque. It contains pigment cells, and the muscle fibres are of large size.

The post-abdomen is much larger than any other part of the body, and it is the most prominent feature in sections (Pl. XXVI. fig. 12, *p.ab.*) and in teased preparations of the colony. It is an elongated thread-like body of much the same width throughout, and quite opaque. At its posterior termination there is a slight knob resembling a rudimentary vascular appendage. In sections (Pl. XXVI. fig. 12, *p.ab.*) the post-abdomen is seen to be divided throughout its entire length by the usual double septum, on each side of which lies an opaque cellular mass in which the reproductive elements are formed.

Amaroucium nigrum, n. sp. (Pl. XXXI. figs. 17–19).

The Colony is irregularly club-shaped. It is attached by a small base from which it gradually enlarges to a much wider upper end. It is not compressed laterally. The upper end has an obliquely truncated appearance. The surface is uneven. The colour is black.

The length is 1·6 cm., the greatest breadth is 5 mm., and the greatest thickness is 4 mm.

The Ascidiozooids are of moderate size, but are few in number. They are placed vertically in the colony, and their anterior ends form small projections on the surface of the upper end; otherwise they are not visible externally.

The Test is firm and cartilaginous. It is of a very dark grey-brown colour internally, and is black on the surface. It is quite opaque. The test cells are very abundant, and are mostly of elongated, fusiform, and branched shapes. They are all very granular, and some of them are of large size, and are pigmented. No bladder cells are present.

The Mantle is thick and opaque, and the musculature is well developed. The muscle bands are mainly longitudinal in direction, and they are rather wide.

The Branchial Sac is small, and is not well developed. The stigmata are short and rounded.

Locality.—Royal Sound, Kerguelen Island; depth, 28 fathoms.

A single specimen of this remarkable looking species was obtained at Royal Sound, Kerguelen Island, from a depth of 28 fathoms. It is a small black colony of elongated form, tapering from a wide irregularly shaped upper end downwards to a small area of attachment at the opposite extremity (Pl. XXXI. fig. 17). The lower part, or stalk, is irregular and slightly twisted. No common cloacal aperture is visible. The colour on

the edges, when held to the light, is a very dark brown, but on the surface it looks quite black.

The test is hard and tough. In thin sections it is transparent, but in mass is quite opaque. The structureless matrix is densely crowded with test cells. In some places they are so numerous as almost to touch one another (Pl. XXXI. fig. 18, *t.c.*). These test cells are nearly all spindle-shaped or stellate, with large central nuclei, and with the protoplasm so full of small dark granules that it might almost be called pigmented. In addition, however, there are larger cells of ovate or globular form which are much more deeply coloured and are true pigment corpuscles. The pigment granules are dark brown or nearly black in colour.

Each longitudinal muscle band in the mantle has four to eight fibres (Pl. XXXI. fig. 19, *m.b.*), and these fibres are exceptionally broad. Some parts of the mantle are slightly pigmented (Pl. XXXI. fig. 19, *p.c.*). The branchial sac is thick walled and opaque, and the stigmata are inconspicuous.

The alimentary canal is moderately large. The stomach is rounded, and its wall is folded longitudinally.

The post-abdomen is short, and in the Ascidiozooids examined the reproductive organs were in an undeveloped condition.

Psammaplidium, n. gen.

Colony incrusting, massive, or lobed.
Systems inconspicuous.
Ascidiozooids usually small, not much elongated, and not distinctly divided into regions.
Test thick, and greatly strengthened by imbedded and incrusting sand-grains and other foreign bodies which form a great part of its bulk.
Branchial Sac small, and not well developed.
Post-Abdomen usually short.

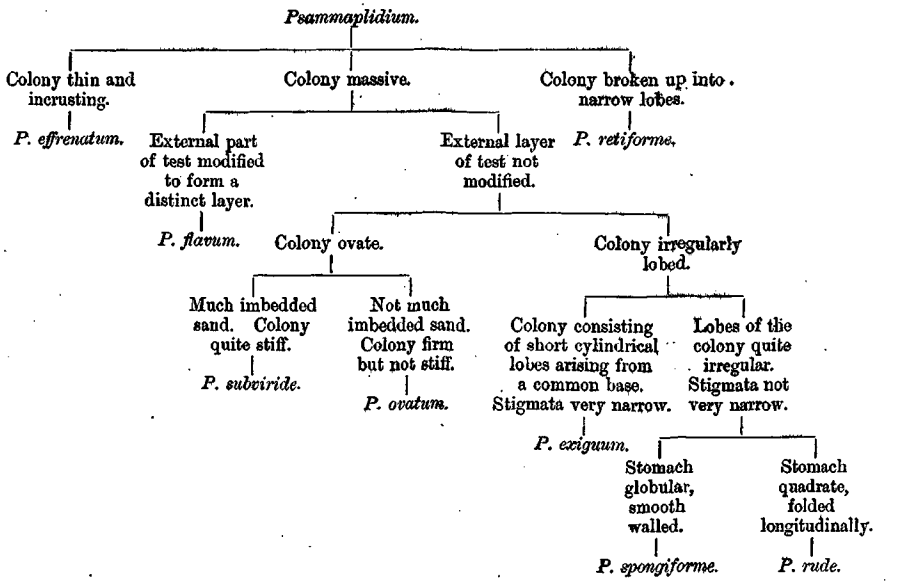
I have separated this group of species from the other Polyclinidæ on account of the very abnormal condition of the test which they exhibit. This region of the colony in all of these species contains, in a more or less marked degree, sand and shell fragments, &c., and these foreign bodies constitute, in most cases, a very considerable part of the investing mass. This sand is not merely incrusting, but the grains are actually imbedded in and surrounded on all sides by the test substance. Evidently in this genus the test has the power, during its whole development, of taking up foreign particles in large numbers and of finally growing over them, so that they come to be placed in its interior. This power is of course seen, to a limited extent, in the region of the test which forms the base of attachment in any fixed colony, and in the branched hairs

which are prolonged from the outer surface of the test in the case of most Molgulidæ and some Cynthiidæ amongst the Simple Ascidians, and in *Polyclinum sabulosum*, Giard, a member of the present family. In the description of the last named form, Giard[1] makes no mention of imbedded sand grains in the test, and consequently we may infer that the sand is merely adhering to the surface of the hair-like processes which he describes. I think it is probable that von Drasche's *Aplidium asperum* belongs to the present genus. He does not figure a section of the test, but from his description[2] it appears that there are many imbedded sand grains. It differs from all the Challenger species.

One result of the presence of imbedded sand in this genus is that the colony is rendered hard, brittle, and opaque. The Ascidiozooids are generally not visible externally, and are in some cases rather difficult to dissect out both on account of their small size and because of the surrounding sand grains.

The condition of the stomach varies in the genus; in some cases it is smooth (*Psammaplidium spongiforme*), in others it is folded longitudinally (*Psammaplidium incrustans*).

In external form also the species vary greatly, as is shown in the following synoptic table of the genus.[3]


Psammaplidium.
Colony thin and incrusting.
Colony massive.
Colony broken up into narrow lobes.
P. effrenatum.
External part of test modified to form a distinct layer.
External layer of test not modified.
P. retiforme.
P. flavum.
Colony ovate.
Colony irregularly lobed.
Much imbedded sand. Colony quite stiff.
Not much imbedded sand. Colony firm but not stiff.
Colony consisting of short cylindrical lobes arising from a common base. Stigmata very narrow.
Lobes of the colony quite irregular. Stigmata not very narrow.
P. subviride.
P. ovatum.
P. exiguum.
Stomach globular, smooth walled.
Stomach quadrate, folded longitudinally.
P. spongiforme.
P. rude.

[1] Recherches sur les Asc. Comp. ou Synascidies, *Archives d. Zool. expér.*, t. i. p. 643.

[2] Die Synascidien der Bucht von Rovigno, p. 26.

[3] To these eight species must be added a ninth, *Psammaplidium pyriformis* (see Appendix B. at the end of this Report). It is closely allied to *Psammaplidium subviride*, but differs from that species in its pyriform shape, its colour, and the condition of its mantle and branchial sac.

Psammaplidium spongiforme, n. sp. (Pl. XXXII. figs. 1–5).

The Colony is an irregularly lobed mass of large size. It is attached by a comparatively small area, and from this base rise several closely placed large flattened expansions with irregularly lobed free ends. All of the edges and processes are rounded. The surface is irregular, rough, and sandy. The colour is a yellowish-grey, the colour of the sand.

The length of the entire colony is 6 cm., the greatest breadth is 10 cm., and the greatest thickness 4 cm.

The Ascidiozooids are very minute, and are not visible on the outside of the colony; and, on account of the enormous quantity of sand imbedded throughout all parts, it is rather difficult to discover them even when the colony is dissected. They do not seem to be arranged with regularity, but circular common cloacal apertures are present, chiefly on the upper parts of the expansions and lobes. The bodies of the Ascidiozooids are about 1 mm. in length and 0·3 mm. in breadth. They are not divided externally into regions.

The Test is solid and firm, but very brittle. It is closely packed in all parts with imbedded sand-grains. The test cells are numerous but very small. The matrix is clear and homogeneous. No bladder cells are present.

The Mantle is moderately thick and muscular. The muscle bands are all longitudinal in direction, and are not distant.

The Branchial Sac occupies about one half of the length of the body. The stigmata are not large, and they are rather inconspicuous. They are of an elliptical form with rounded ends.

The Endostyle is large and conspicuous. Its course is undulating.

The Alimentary Canal forms a loop of considerable size. The stomach is globular and smooth walled. The rectum is relatively wide.

The Post-Abdomen is very short and is not separated from the intestinal loop. It contains both male and female reproductive organs.

Locality.—Port Jackson, Australia, April 1874; depth, 7 fathoms.

A single specimen and some fragments of this large and striking species were obtained at Port Jackson, Australia, from shallow water. The colony is very like a Sponge. It consists of four large irregular flabelliform expansions united at their lower ends where they have a common base of attachment (Pl. XXXII. fig. 1). The upper ends and free edges of these expansions bear irregularly rounded lobes or knobs. The imbedded sand-grains are so numerous that the colony looks as if it were entirely composed of sand. This is the cause of the rough surface and of the colour. A few shell fragments and other foreign bodies are attached or imbedded at the lower end of the colony near the base of attachment. The common cloacal apertures are numerous (Pl. XXXII. fig. 1).

They are all wide open and are each about 1·5 mm. in diameter. Probably the stiffness of the test caused by the sand prevents the apertures being closed.

When a section is made across one of the lobes of the colony it is seen that the Ascidiozooids are placed at right angles to the surfaces and extend from each side about one-third of the way inwards, while the central and remaining third is even more sandy than the outer surface.

The Ascidiozooids are very minute, although the colony is of such large size, and as they are surrounded on all sides by grains of sand, many of them of about their own size, it is rather difficult to make them out. When removed from the test and cleared of sand they are found to be cylindroidal in shape (Pl. XXXII. fig. 2). There is no separation into regions, and the breadth is very much the same all along the body. The thorax is usually about half the total length, and the abdomen the remainder; the post-abdomen is exceedingly short (Pl. XXXII. figs. 2, 5). So much imbedded sand is present in this species that the amount of test substance is very small relatively to the size of the colony. There is far more sand than test in the mass which invests the Ascidiozooids. The presence of this sand makes the test firm but brittle, changes its colour, and renders it quite opaque.

The branchial siphon is short, and the aperture is surrounded by six short lobes (Pl. XXXII. fig. 2). The atrial aperture is provided with a languet.

The branchial sac is rather thick walled and opaque. In most cases the stigmata are small and rounded, and both the transverse and the fine longitudinal vessels are wide (Pl. XXXII. fig. 4, *tr.*), but in one of the Ascidiozooids examined the stigmata were found to be larger and more numerous and the vessels much smaller than usual (see Pl. XXXII. fig. 3, *tr.*). The endostyle is very wide (Pl. XXXII. fig. 2, *en.*).

The œsophagus is short, and leads straight backwards to the large globular stomach (Pl. XXXII. fig. 5, *st.*) which lies on the ventral edge of the abdomen about half way back. The wall of the stomach is thick, but is not folded. The intestine leads back from the stomach for some distance, and then turns dorsally and anteriorly to become the rectum (Pl. XXXII. fig. 5, *i.* and *r.*). The intestine varies in calibre; on leaving the stomach it widens for a short distance, then narrows and then finally widens again before turning dorsally. The loop between the intestine and the rectum is moderately wide, and the abdomen as a whole is about as large in every way as the thorax. The rectum is long and is very conspicuous on account of the dark-coloured balls of fæcal matter which it contains (Pl. XXXII. figs. 2, 5, *r*). It varies in calibre according to the amount of its contents.

The post-abdomen forms merely a small rounded projection on the lower end of the intestinal loop (Pl. XXXII. fig. 5, *p.ab.*). The ova and the spermatic vesicles are closely placed and lie alongside one another. The vas deferens was not visible in the Ascidiozooids examined. No larvæ were found.

Psammaplidium effrenatum, n. sp. (Pl. XXXII. figs. 6, 7).

The Colony is an irregular incrusting mass of large size. It is attached by an extended base to a dead fragment of coral, and does not attain any great thickness. The surface is irregular and rough. The colour is dark brown.

The length is about 7·5 cm., the breadth 4 cm., and the usual thickness 8 mm.

The Ascidiozooids are of small size, and are not much elongated. They are fairly numerous and are placed rather closely over the upper surface of the colony, an arrangement in systems being visible in some places. The body is usually about 2·5 mm. in length and less than 1 mm. in greatest breadth. The post-abdomen is distinctly marked off from the anterior part of the body.

The Test is relatively small in amount and contains great quantities of imbedded sand grains of a dark colour. The matrix where free from impurities is clear and transparent and of a light grey tint. The test cells are small and inconspicuous. They are not numerous, but show the usual variety of form. No bladder cells are present.

The Mantle is thick and opaque, and the musculature is moderately strong. Most of the muscle bands run longitudinally.

The Branchial Sac is small, and is not well developed. The stigmata are few in number and of rounded form. The ciliated cells are inconspicuous.

The Endostyle is large and its course is undulating.

The Alimentary Canal forms a long narrow loop. The stomach is relatively small, and the rectum is large.

The Post-Abdomen is not large. It is narrow and tapers posteriorly.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2 F.

Two broken colonies of this species were obtained off the east coast of South America, at a depth of 600 fathoms. They are large incrusting masses of a dull brown colour (Pl. XXXII. fig. 6). The two specimens differ slightly in their colour, one is of a reddish-brown and the other is a dark grey-brown. In the former the Ascidiozooids are of a yellow colour, while in the latter they are opaque white.

The colony does not rise to any height above the place of attachment, but it becomes thicker at the free edges where it has grown beyond the coral which it surrounds. The upper surface is of large extent, and is flat or slightly convex. No common cloacal apertures are visible. In some places the Ascidiozooids (which are only visible as slight elevations) seem to be arranged in irregular lines which resemble the elongated systems found in the genus *Botrylloides*, but in other parts there is no definite arrangement (Pl. XXXII. fig. 6).

The numerous sand grains imbedded in the test cause its stiffness, give it its dark

colour, make the surface rough, and render the whole colony opaque. On making a section of the colony the Ascidiozooids, which are easily removed, are found to lie in small cavities separated by narrow partitions formed of test substance and sand grains. The Ascidiozooids although small are conspicuous on account of the contrast between their light yellow colour and the dark surrounding test. They are placed nearly at right angles to the upper surface. The test cells are granular and are generally of branched forms, but they are not pigmented and are usually very inconspicuous.

The mantle is fairly muscular over all parts of the body (see Pl. XXXII. fig. 7). The branchial aperture is distinctly six-lobed, and the sphincter is well developed. The wall of the branchial sac is rather thick and opaque.

The atrial aperture is circular and has no lobes and no languet. It is placed on the dorsal edge at some distance from the branchial aperture. In this respect this species resembles the genus *Aplidium*.

The stomach is moderately large. It is globular, and has its wall slightly folded longitudinally. The spermatic vesicles are of considerable size. They are ovate or spherical in form, and the vas deferens is conspicuous.

Psammaplidium rude, n. sp. (Pl. XXXI. figs. 1–4).

The Colony is an irregularly lobed sandy mass. It is incrusting and is attached by a broad base. The upper surface is wide and usually flattened, with low projections or knobs. The surface is uneven and rough. The colour is greyish-yellow, the colour of the sand.

The length is about 1·5 cm., the greatest breadth is 2·5 cm., and the thickness is 1·5 cm.

The Ascidiozooids are not visible on the outside of the colony, and no common cloacal apertures are to be seen. The body is about 3 mm. in length and scarcely 1 mm. in breadth. The thorax, which is about 1·5 mm. in length, is indistinctly separated from the rest of the body.

The Test contains a large amount of imbedded and incrusting sand, which renders it stiff but brittle and quite opaque. The matrix is clear and structureless. The test cells are minute and not very numerous. No bladder cells are present.

The Mantle is thin and transparent, but fairly muscular. On the thorax the muscle bands are mainly transverse in direction, and are branched so as to form an irregular network. On the post-abdomen the muscle bands run longitudinally.

The Branchial Sac is large and well developed. The transverse vessels are moderately wide, and all of the same size. The stigmata are numerous; they are well developed, and are arranged with regularity. The ciliated cells are distinct.

The Dorsal Lamina is represented by a series of very short stout tentacular languets.

The Tentacles are long and slender.
The Alimentary Canal forms a long narrow loop.
The Post-Abdomen is not large.
Locality.—Unknown.

There are about half a dozen irregular and more or less fragmentary colonies of this species in the collection. The locality where they were obtained is unknown.

The shape of the colony appears to be quite indefinite. It forms irregular incrusting masses from 1 cm. to 2 cm. in height, and of varying extent and thickness (Pl. XXXI. figs. 1, 2). No traces of cloacal apertures or of any arrangement of Ascidiozooids in systems is visible. The dimensions given in the above description are those of one of the larger specimens in the collection, but probably it is not a complete colony.

The test is penetrated in all parts by sand grains, which are so abundant that the colony both outside and in sections looks as if it were merely a mass of sand (Pl. XXXI. figs. 1, 2). The roughness, the opacity, the colour, and the stiff and brittle condition of the test are all due to the presence of the imbedded sand grains. The investing mass around the Ascidiozooids contains more sand than test substance, and the test where free from impurities is clear and transparent.

The musculature of the mantle over the thorax (Pl. XXXI. fig. 3, *m.b.*) is rather like that of some of the Ascidiidæ amongst Simple Ascidians. The six lobes around the branchial aperture are very large and distinct (Pl. XXXI. fig. 3, *br.*).

The atrial aperture is placed on the dorsal edge, at a considerable distance from the anterior end. It is circular and has no lobes on the margin (Pl. XXXI. fig. 3, *at.*) A long tapering atrial languet (*at.l.*) is present on its anterior edge between it and the branchial aperture. The transverse muscle bands are placed with regularity on the sides of the body (Pl. XXXI. fig. 3, *m.b.*), but form a network on the ventral edge over the endostyle. The mantle is generally very transparent, but in some of the Ascidiozooids it is found to be considerably pigmented.

The transverse vessels of the branchial sac are provided with strong muscle bands (Pl. XXXI. fig. 4, *m.f.*), and they are all joined to the mantle by connectives. The stigmata at the ventral end of each row become much smaller, so as to allow the transverse vessels to expand into large triangular areas. At the dorsal edge of the sac the stigmata are not interrupted by a dorsal lamina (Pl. XXXI. fig. 4) but pass continuously from one side to the other between the languets.

The endostyle is large and conspicuous. Its course is undulating. The dorsal languets are remarkably short and stout (Pl. XXXI. fig. 4, *l.*); their ends are blunt. The nerve ganglion is large and of elliptical form. It is placed half way between the branchial and atrial apertures and just in front of the atrial languet (Pl. XXXI. fig. 3, *n.g.*).

The œsophagus is long and narrow, and runs posteriorly to open into the large quadrate stomach. The walls of the stomach are moderately thick and are thrown into a few slight longitudinal folds. The intestine is long and thin walled. It runs posteriorly from the stomach for a considerable distance and then turns abruptly to the dorsal edge and anteriorly so as to form a narrow loop. The rectum is very like the intestine. In some cases it is wide, when distended with food matter. The anus is placed behind the middle of the branchial sac, usually about two-thirds of the way down from the anterior end. It is a small aperture with a thickened and reflected margin.

The spermatic vesicles are globular in form. The vas deferens is not so large and conspicuous as is usual amongst Compound Ascidians. In several of the Ascidiozooids examined mature ova were found in the peribranchial cavity, usually very far forward, close to the branchial aperture, but no embryos or larvæ were seen.

Psammaplidium subviride, n. sp. (Pl. XXXI. figs. 5–10).

The Colony has an irregularly rounded or ovate form. It is attached by the lower end and is not compressed laterally. The surface is even but is slightly roughened all over. The colour is a pale opaque greenish-grey.

The length is 2·5 cm., the breadth is 1·3 cm., and the thickness is 1 cm.

The Ascidiozooids are rather small but numerous. They are scattered evenly all over the surface, and are not arranged in systems. They lie at right angles to the surface of the colony, but their bodies are usually not much elongated.

The Test is hard and firm. It contains great quantities of imbedded sand grains in all parts. Where free from impurities it is clear and transparent, and is of a pale grey colour. The test cells are abundant. They are mostly of rounded form and have granular protoplasm. No bladder cells are present.

The Mantle is thin and its musculature is feeble. The narrow muscle bands run longitudinally.

The Branchial Sac is well developed. The transverse vessels are wide. The stigmata are narrow and exceedingly long. The ciliated cells are rounded and not very conspicuous.

The Endostyle is wide. Its course is undulating.

The Dorsal Lamina is represented by a series of short horn-like languets.

The Alimentary Canal forms a long and very narrow loop. The stomach is small but the intestine is large.

The Post-Abdomen is very variable in size. It is always narrow. It contains both male and female reproductive organs.

Locality.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ W.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47° F.

Nine colonies, some of them fragmentary, of this species were obtained off the Cape of Good Hope, at a depth of 150 fathoms. Some of them are rather irregular in form and they are all incrusted with sand (Pl. XXXI. fig. 5). The colour, which is due mainly to the sand grains in the test, is light grey with a distinct greenish tint. Some of the colonies have more imbedded and incrusting sand than others, the result being that they are harder and rather darker and show no traces of Ascidiozooids. In all cases the colony is quite opaque.

Where they are visible the Ascidiozooids show as circular, less opaque, areas rather less than 1 mm. in diameter. They are closely placed, and occupy the whole outer surface of the colony with the exception of the lower end where it is attached.

The test is occupied in all parts by the imbedded sand grains, Foraminifera shells, Sponge spicules, and other foreign bodies, so that very little of the test substance can be seen in sections (see Pl. XXXI. fig. 9). In some places the granular test cells are very abundant.

The mantle is transparent in all parts of the body, and the musculature is as strong on the abdomen and post-abdomen as on the thorax. The branchial siphon is long (Pl. XXXI. fig. 7), and the aperture is distinctly six-lobed. The sphincter muscle is well developed. The atrial aperture is provided with a very large atrial languet (Pl. XXXI. fig. 7).

The stigmata of the branchial sac are remarkably long (see Pl. XXXI. fig. 6, *sg.*) and resemble those of *Colella pedunculata* amongst the Distomidæ. The dorsal languets are very short (Pl. XXXI. fig. 8); and the endostyle though wide is not conspicuous.

The œsophagus runs straight backwards and opens into the small narrow stomach, the wall of which is folded longitudinally. The intestine is nearly as wide as the stomach. It runs posteriorly for a considerable distance after leaving the stomach, and then turns abruptly to the dorsal edge and anteriorly to become the rectum. The loop thus formed is exceedingly narrow. The rectum is large and thin-walled.

The post-abdomen is in some Ascidiozooids almost absent, while in others it is a long and narrow region of the body (Pl. XXXI. fig. 10). The ova (*o.*) occur about the middle of its length, while the small ovate spermatic vesicles are placed more posteriorly (Pl. XXXI. fig. 10, *t.v.*) The vas deferens (*v.d.*) is large and conspicuous.

Psammaplidium exiguum, n. sp. (Pl. XXXI. figs. 11–12).

The Colony is in the form of one or more short cylindrical projections from a common irregular incrusting base. The upper end is more or less rounded. The surface is sandy and rough. The colour is dark grey.

The length, excluding the common base, is 6 mm., the breadth 4 mm., and the thickness 3 mm.

The Ascidiozooids are of fair size, and not numerous. There is probably a common cloacal aperture on the summit of each of the projections, and the Ascidiozooids are arranged in a group round these.

The Test is full of imbedded sand grains which render it opaque, hard, and brittle. The matrix is clear and homogeneous. The test cells are abundant and of fair size. No bladder cells are present.

The Mantle is fairly thick and muscular.

The Branchial Sac is rather small and thick walled. The transverse vessels are wide, and all of one size. The stigmata are narrow but fairly regular.

The Endostyle is wide and conspicuous. Its course is undulating.

Locality.—Station 141, December 17, 1873; lat. 34° 41′ S., long. 18° 36′ W.; depth, 98 fathoms; bottom, green sand; bottom temperature, 49°·5 F.

A single specimen of this species was obtained off the Cape of Good Hope from a depth of 98 fathoms. It is a small irregular sandy mass (Pl. XXXI. fig. 11), and in external appearance seems as if it were closely allied to *Psammaplidium subviride*. The two species, however, differ greatly in their branchial sacs (compare Pl. XXXI. fig. 6 with Pl. XXXI. fig. 12). The colour, texture, roughness, and opacity of the colony are all due simply to the presence of the sand grains, Foraminifera shells, and other foreign bodies.

The Ascidiozooids are scarcely visible externally, and are rather deeply placed in the colony. They are difficult to find on account of the imbedded sand surrounding them. The test cells are mostly of rounded form and have granular protoplasm.

In the branchial sac the stigmata are narrower than the fine longitudinal vessels (Pl. XXXI. fig. 12, *l.v.*). The ciliated cells are distinct and have pointed free ends. The cilia are very long. The wide transverse vessels are provided with muscle fibres (Pl. XXXI. fig. 12, *tr.*).

Ova are present in the post-abdomen, but no male reproductive organs are visible. Well developed tailed larvæ were found in the peribranchial cavity of one Ascidiozooid.

Psammaplidium ovatum, n. sp. (Pl. XXXI. figs. 13–16).

The Colony is an irregularly rounded mass fixed by one end and having the upper part broad and convex. The surface is even, but roughened all over. The colour is a dull dark grey.

The length is 2·3 cm., the breadth 1·2 cm., and the thickness 9 mm.

The Ascidiozooids are fairly large and numerous. They are scattered over the upper surface of the colony and seem to have no arrangement in systems. They lie generally with their antero-posterior axis perpendicular to the surface of the colony. The body is

about 4 mm. in length and scarcely 1 mm. in greatest breadth. The post-abdomen is much narrower than the anterior portion of the body, but the thorax and abdomen are not distinctly separated.

The Test is moderately firm and tough. There is a certain amount of incrusting and imbedded sand, but not sufficient to render the mass stiff or brittle. In the interior of the colony the test is of a light grey colour and semi-transparent. The matrix is clear and structureless. The test cells are not very abundant, and are mostly small but irregular and much branched forms. No bladder cells are present.

The Mantle is strong and the musculature is well developed. Over the anterior part of the body both longitudinal and transverse muscle bands are present, while in the post-abdomen they are all longitudinal and are rather closely placed.

The Branchial Sac is large and well developed. The transverse vessels are moderately wide and are provided with muscle fibres. The stigmata are fairly long and are placed with regularity.

The Tentacles are long and thin. They are of two sizes.

The Alimentary Canal is relatively of very small size, and forms a short loop.

The Post-Abdomen is long and narrow.

Locality.—Torres Strait, north of Australia; depth, 3 to 11 fathoms.

Two colonies of this species were obtained in shallow water off Cape York at the northern extremity of Australia. They differ somewhat in shape, the one being ovate with the long axis vertical (Pl. XXXI. fig. 13), and the other roughly hemispherical with the long axis horizontal. The dimensions given above are those of the former specimen, the latter measures 1·2 cm. in length, 2·5 cm. in breadth, and 1·5 cm. in thickness.

No common cloacal apertures are visible on either of the colonies. The Ascidiozooids are seen externally as small circular areas slightly elevated above the general surface (Pl. XXXI. fig. 13). In some places the open branchial apertures are visible. The shape of the Ascidiozooid is remarkable. The thorax and abdomen form a single cylindrical mass, tapering posteriorly into the long narrow post-abdomen (Pl. XXXI. fig. 15, *p.abd.*).

The amount of sand imbedded in the test is not nearly so great as in the case of some allied species (*e.g.*, *Psammaplidium spongiforme* and *Psammaplidium subviride*). It is enough, however, to render the colony opaque and roughen its outer surface. Some of the test cells are very coarsely granular, and a few are slightly pigmented. The transverse muscle bands in the mantle are very well marked (Pl. XXXI. fig. 15, *m.*). The lobes around the branchial aperture are distinct, and the sphincter is well developed (Pl. XXXI. fig. 15).

The endostyle is narrow, but has a very undulating course. In the young Ascidiozooid, however, where there are only three rows of stigmata in the branchial sac, the endostyle is quite straight (Pl. XXXI. fig. 16, *en.*). The interstigmatic vessels

of the branchial sac are narrow (Pl. XXXI. fig. 14, *l.v.*). Some of the tentacles are very long. They project for a considerable distance beyond the branchial aperture, and then are directed anteriorly.

Psammaplidium retiforme, n. sp. (Pl. XXXII. figs. 8–10).

The Colony consists of a number of elongated, club-shaped or wedge-shaped masses, compressed laterally and united together by a narrow irregular and branched creeping stolon. The upper ends of the flattened masses are usually broad and rounded. The lower ends where they join the stolon are narrow. The surface of the whole colony is irregular and slightly rough from the presence of adhering sand particles. The colour is a dull greyish-buff.

The average length of one of the masses forming the colony is 2·5 cm., and the breadth is 7 mm. at the widest part; the thickness is about 2 mm.

The Ascidiozooids are not visible on the outside of the colony, which is quite opaque. A small number of them are found in each of the separate parts of the colony. They are placed vertically and are of moderate size.

The Test is small in amount. It is firm and rather tough, of a whitish-grey colour where free from sand and Ascidiozooids, and rather opaque. Its outer layer contains imbedded sand grains and great quantities of siliceous Sponge spicules and Diatoms. The test cells are minute and not numerous. The matrix is clear and structureless. There are no bladder cells present.

The Mantle is fairly thick but not opaque. The muscle bands are strong but distantly placed.

The Branchial Sac is large and well developed. The transverse vessels are numerous, moderately wide, and all of the same size. The stigmata are closely placed and arranged with regularity.

The Tentacles are large and numerous, they are so closely placed that their bases nearly touch one another.

The Alimentary Canal is of moderate size. The stomach is folded longitudinally, and the rectum is wide and thin-walled.

The Post-Abdomen is long and narrow, and contains both male and female reproductive organs.

Locality.—Off Christmas Harbour, Kerguelen Island, January 29, 1874; depth, 50 to 120 fathoms.

One large colony and some fragments of this remarkable form were obtained off Christmas Harbour, Kerguelen Island, from a depth of 50 to 120 fathoms. It has a superficial resemblance to the Clavelinidæ amongst Simple Ascidians, and is certainly

very different in external appearance from all other known Compound Ascidians (see Pl. XXXII. fig. 8).

The Ascidiozooids occupy flattened elongated masses varying from 4 mm. to 3 cm. in length, and from 2 mm. to 8 mm. in breadth at the broadest part. These are connected by branching stolons so as to form a rude network (Pl. XXXII. fig. 8). Probably the stolon was slightly attached to some foreign object, and the remainder of the colony lay in a recumbent or semi-erect position. Its sandy condition suggests that it probably trailed over a sandy bottom. Each of the flattened masses rising from the stolon contains a few Ascidiozooids which may be regarded as forming a system. No common cloacal apertures, however, are visible. If present, they are probably placed in the middle of the upper end.

The test does not become thickened in any part of the colony. It merely forms a thin but tough skin around each group of Ascidiozooids, and is greatly strengthened by imbedded foreign bodies. Some of the Sponge spicules attached to the surface are of large size, from 1 cm. to 2 cm. in length.

The branchial siphon is well formed, and the aperture is surrounded by six elongated lobes (Pl. XXXII. fig. 10, *br.l.*). The sphincter is well developed. The atrial aperture is provided with a short languet. The stigmata though not large are well formed (Pl. XXXII. fig. 9, *sg.*). The ciliated cells are distinct, and have pointed free ends. The rectum is filled with fragments of Diatoms, Sponge spicules, and minute sand grains.

The ova are large and of a bright yellow colour. The vas deferens is large and conspicuous. The spermatic vesicles are rather small and of a pale colour; they are ovate in shape.

In some of the Ascidiozooids tailed larvæ were found in the peribranchial cavity. They have each two pigmented sense-organs placed close together near the posterior end of the body. Large groups of ectodermal processes are present at the anterior end.

Psammaplidium flavum, n. sp. (Pl. XXXII. figs. 11–13).

The Colony is a small irregularly hemispherical mass attached by a wide base. The upper end is convex. The colour is a dull opaque yellowish-brown. The surface is even but finely roughened all over.

The length is 1 cm., the breadth 1·5 cm., and the greatest thickness 1·4 cm.

The Ascidiozooids are rather small and not very numerous. They are not visible until the colony is cut open. The usual size is about 3 mm. in length and less than 1 mm. in greatest breadth. They are quite opaque and are not divided into regions externally.

The Test is hard and firm, but not tough. It is of a yellowish-brown colour externally, but dull grey in the interior of the colony; it is quite opaque all through. The matrix

is densely crowded with test cells of rather large size and various shapes. There are also grains of sand in considerable quantity imbedded in the test, and masses of pigmented test cells are present in the outer layer.

The Mantle is well developed, and the muscle bands are strong. Most of them run in a longitudinal direction.

The Branchial Sac is long and narrow. The transverse vessels are all of one size. The stigmata are small and inconspicuous.

The Alimentary Canal is relatively small and forms a short loop.

The Post-Abdomen is large. It is as wide as the anterior part of the body.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2 F.

This species does not look like a Compound Ascidian when seen from the outside (Pl. XXXII. fig. 11). It is peculiarly interesting on account of the modification of the external layer of the test, and also on account of the very considerable depth (600 fathoms) from which it was obtained.

It is attached by a large spreading base which extends somewhat beyond the edge of the colony and is of a dark grey colour. From this rises a low dome-shaped mass of a dull yellowish-brown colour and with a finely roughened surface. It is perfectly opaque, and no Ascidiozooids or marks indicating their presence are visible (Pl. XXXII. fig. 11).

On making sections of the colony it is found that the colour is due to the outer layer of test, the inner parts being of a dark opaque grey. In this inner region the dull yellow bodies of the Ascidiozooids are seen penetrating the test in all directions. They are not arranged with any regularity, and they are inclined at various angles to the surface.

The test although stiff is brittle, probably a result of the numerous imbedded sand grains, shell fragments, sponge spicules, &c. The test cells are large and granular; they vary greatly in shape. The most remarkable point, however, in the test is the presence in the outer layer of a great number of closely placed masses of large granular cells (Pl. XXXII. fig. 13, *tc'.*); the cell masses are usually of a rounded form, or polygonal from mutual pressure (see Pl. XXXII. fig. 12). It is these masses which, by making the test above them project slightly, form the roughness which is visible on the external surface of the colony. At first I was inclined to regard them as enlargements upon vessels in the test corresponding to the terminal knobs found in the outer layer of the test of some species of *Culeolus*[1] and some of the Botryllidæ (see Pl. III. fig. 9, *t.k.*). A careful examination of the test, however, showed that no vessels were present, and that the cavities in the test matrix, in which the masses of cells were placed (Pl. XXXII. fig. 12), had no tubes leading from them, but were closed upon all sides. Therefore I am now disposed to consider the cells as modified test cells and not as blood-corpuscles.

[1] See Part I. of this Report, p. 91, pl. viii. fig. 2, 1882.

The individual cells are large and rounded, and have very granular protoplasm (Pl. XXXII. fig. 13, *tc'*.) Probably they correspond to the clumps of pigmented test cells found in *Atopogaster aurantiaca* (see p. 170, and Pl. XXIII. fig. 9, *p.c.*) and *Amaroucium lævigatum* (see p. 232, and Pl. XXX. fig. 15) and some other species.

The musculature of the mantle is very strong, and the individual muscle fibres are large. The mantle is very opaque.

The branchial sac is very narrow and the stigmata are feebly developed. The wall of the sac is opaque.

An additional species of the genus, *Psammaplidium pyriforme*, will be found described in Appendix B. at the end of the Report.

Genus doubtful.

The following species, on account of its condition, cannot be assigned to its genus with any certainty.

———— (?) *ignotus*, n. sp. (Pl. XXVIII. figs. 14, 15).

The Colony is a very long, narrow, and somewhat irregular mass probably attached by one end, the rest of the colony lying on the sea-bottom. The lower end is prolonged into a number of filamentous projections to which sand grains and stones are attached. The widest part of the colony is about half-way up, and from that point it tapers to the upper end. The edges are very irregular. The surface is uneven and rough, and the colour is a light grey, irregularly spotted with light yellow and with dark patches of sand.

The length is 48 cm., the greatest breadth is 3 cm., and the thickness varies from 1 to 2 cm.

The Ascidiozooids are of fair size, but are not very numerous. They are apparently arranged quite irregularly over the surface of the colony.

The Test is, considering its bulk, very soft and spongy. Its outer surface is quite irregular, and it is of the same consistence throughout. It is of a light grey colour, and rather opaque. The matrix is generally homogeneous, but in some places it is delicately fibrillated. It is crowded with test cells, most of which are of rounded forms and rather granular.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

This is an interesting species on account of its very great size, but most unfortunately all the colonies I have seen are in such very bad condition that almost nothing can be made out in regard to the structure of the Ascidiozooids. There are two specimens in the Challenger collection, both from the Strait of Magellan, and in the British Museum

collection there is a large colony (about 3 feet in length[1]) labelled "Antarctic" which I believe belongs to the same species.

The British Museum specimen appears to be in a semi-decayed condition, the surface is irregular, and the Ascidiozooids are many of them partially ejected from the test. Both ends of the colony are frayed out, and one of them is in a matted condition and was probably the point of attachment. From the presence of sand grains adhering to the surface all along the specimen it is very probable that the colony was unable to grow erect, and simply lay along the sea-bottom.

The two specimens in the Challenger collection are even in worse condition for anatomical purposes. The whole of the surface is evidently decayed and rotten. The bodies of the Ascidiozooids are exposed, and are more or less torn and displaced, while even those which are in their natural positions are so decomposed that it is impossible to make out anything definite as to their structure. One colony, from which the above description and measurements were taken, is apparently complete (Pl. XXVIII. fig. 14, represents this colony on a reduced scale), the other is probably only a fragment. The complete colony consists of (1) a basal portion about 2 cm. in length, and frayed out into rootlets to which sand and stones are attached, (2) a region immediately above this, and measuring 3 cm. in length, where the test is solid but there are no Ascidiozooids, and (3) the rest of the colony, about 43 cm. in length, where there are Ascidiozooids scattered irregularly all over the surface (see Pl. XXVIII. fig. 14). The second specimen measures 25 cm. in its extreme length and 3 cm. in breadth. It is widest about half-way up, and tapers to about 1 cm. in breadth at the top. There is no base of attachment, and probably a good deal of the lower part of the colony is absent. Both specimens have sand grains adhering to the test at various parts of the surface (Pl. XXVIII. fig. 15); they were probably recumbent in position.

The Ascidiozooids show as small rounded yellow bodies about 2 mm. in diameter, imbedded in or partially projecting from the superficial layer of the test (Pl. XXVIII. fig. 15). There appear to be no portions of their bodies in the deeper parts of the colony, the centre being merely a mass of spongy test. The bodies of the Ascidiozooids are quite opaque, and they show no division into regions. Considering the great size of the colony, they are small. On some parts of the surface they are absent for considerable distances (3 or 4 cm.) (Pl. XXVIII. figs. 14, 15), but I believe that this is not the natural condition, but simply the result of the decomposition.

The test is of gelatinous consistence throughout, and, considering its light colour, is remarkably opaque. The test cells are large and very numerous. A microscopic examination of the Ascidiozooids in the Challenger specimens gives no results. The mantle can be made out in a semi-decayed condition, but inside that the branchial

[1] This is the largest Compound Ascidian I have met with.

sac and the intestine and the other viscera are in the form of a mass of granular débris mixed with mud, &c., evidently food matters from the alimentary canal.

The British Museum specimen, which, through the kindness of Dr. Günther, I was permitted to examine, is in better histological condition, and shows the following points in the structure of the Ascidiozooids. The mantle is well developed and is fairly muscular. The chief muscle bands run longitudinally. The branchial sphincter is strong. The endostyle is short but broad, and has an undulating course. The tentacles are all of one size and are numerous. The nerve ganglion is nearly spherical in form.

None of the Ascidiozooids examined showed either the branchial sac or the alimentary and reproductive viscera in sufficiently good condition to allow the details of their structure to be determined. A large conspicuous vas deferens is, however, present, and as it extends for a considerable distance behind the thorax, it may be inferred that a post-abdomen was present.

It is more from the general appearance of the colony and of the Ascidiozooids than from any special points in the anatomy that I place this form in the Polyclinidæ, and in the absence of further information in regard to its structure it is impossible to refer it to its proper genus.

I am inclined to think that both the Challenger specimens and the British Museum specimen were dead and decomposing colonies when they were found and put in spirit. Giard has shown that in some species of Compound Ascidians it is customary at certain seasons for the entire colony to die, and I have myself observed, both on the west coast of Scotland and also in the Chausey Archipelago, off the coast of Brittany, many colonies belonging to several species of Polyclinidæ in a dead and decaying condition. The test is usually in these cases in a soft and spongy state, with an irregular outer surface, and the Ascidiozooids are many of them partially or completely expelled from the colony, just as is the case in the Challenger specimens under consideration. It is to be hoped that some future explorers in the Southern Seas may be successful in obtaining specimens of this, probably the largest known, species of Compound Ascidian in a living condition.

Family IV. Didemnidæ.

Colony usually flat, thin, and incrusting, rarely thick and massive, never pedunculated.

Systems complicated and irregular, inconspicuous, or absent. Common cloacal apertures usually conspicuous.

Ascidiozooids rather small, divided into two regions—thorax and abdomen. Branchial aperture six-lobed, atrial plain, or provided with a languet.

Test gelatinous or cartilaginous, usually containing numerous stellate calcareous

spicules. Ectodermal processes well developed, and provided with muscle fibres.

Branchial Sac small, and not well developed. Rows of stigmata few, usually three or four.

Alimentary Canal united to thorax by a narrow neck. Stomach usually smooth walled.

Reproductive Organs placed alongside the intestinal loop. Male system consisting of a single large testis around which the first part of the vas deferens is spirally coiled.

Gemmation from the pyloric region; thorax and abdomen of the new Ascidiozooid formed from separate buds. Embryonic blastogenesis rudimentary only.

This is a clearly defined family, most of the members of which have a very characteristic appearance, which distinguishes them from all other groups of Compound Ascidians.

The colony is in most cases, like that of most of the Botryllidæ, a flat expanded crust, which may be of any shape (*Leptoclinum*), and is usually of a pure white colour. In some cases, however, the colony becomes thickened to form a large rounded mass (*Didemnum*). It is never much elongated vertically. Common cloacal apertures are usually distinctly visible, and they may be of large size, but the systems are always irregular and difficult to trace.

The Ascidiozooids seem at first sight very like those of the Distomidæ, and Milne-Edwards classed the two groups together as "Didemniens." In both cases the body consists of two regions only, the thorax and the abdomen; and in the Didemnidæ, as in many Distomidæ, these regions are separated by a very narrow neck composed of the œsophagus, the rectum, and the vas deferens, surrounded by a covering of mantle. A more minute examination of the Ascidiozooids shows, however, that in the details of structure the Distomidæ and the Didemnidæ are not really closely allied. In the latter group the branchial sac is feebly developed, and has only three or four rows of small stigmata, while in most of the Distomidæ the branchial sac is large and well developed; the mantle also is characteristic in the Didemnidæ, and it gives off ectodermal processes or vessels which leave the body of the Ascidiozooid not at the posterior end of the body, as in most other Compound Ascidians, but near the anterior end of the branchial sac, where it joins the branchial siphon, and in the neighbourhood of the posterior end of the endostyle. These vessels always contain muscle fibres continuous with those of the mantle, and appear to act, as von Drasche suggests,[1] as retractor muscles serving to change slightly the position of the Ascidiozooid in the investing mass. The vessels arising from the posterior end of the endostyle are provided with terminal knobs or bulbs.

The test or investing mass is usually gelatinous or cartilaginous, and its matrix is clear and structureless, but contains enormous quantities of spherical or stellate calcareous

[1] Die Synascidien der Bucht von Rovigno, p. 31, Wien, 1883.

spicules, which give to most of the Didemnidæ their characteristic appearance. Their presence renders the test hard, brittle, and opaque, and gives it in most cases a gleaming white appearance. Both by sight and by touch, a specimen of the Didemnidæ with calcareous spicules in the test may be readily diagnosed without further examination, while a lens or low power objective places the matter beyond all doubt by showing the numerous white stellate bodies imbedded in the test. In some few species, however, of the family (*e.g.*, *Didemnum tortuosum*, von Drasche), no spicules have been found. Whether this is permanently the case in these species, or is only at a certain time or in a certain condition of the colony, is not yet known. It is quite an exceptional circumstance amongst Didemnidæ.

Another very important characteristic of the family is found in the condition of the reproductive organs. The male system consists of a single very large testis of ovoid form placed on the right side of the intestinal loop, and having a long conspicuous vas deferens, the lower part of which commences its course by coiling spirally around the upper part of the testis for a number of turns. It then runs forward in the usual manner to join the rectum, along which it courses to the peribranchial cavity. The ovary consists merely of a few ova which are placed alongside the vas deferens. The mature ova are of very large size, and they frequently make their way into the common test surrounded by a covering of ectoderm, which they push out before them from the body-wall of the parent Ascidiozooid. How their escape from the common test to the exterior of the colony is effected is not yet known.

The alimentary canal is comparatively simple, and is of much the same relative size in all members of the family. The stomach is large, and is usually of more or less globular or ovate form. Its wall is almost invariably smooth, with no folds, ridges, or other thickenings. In a few cases, however (*e.g.*, *Leptoclinum speciosum*), slight ridges, formed of thickened epithelium, project into the interior, but they are not visible on the outside. In some cases the intestine may be divided into regions of different calibre (*Eucælium hospitiolum*, Savigny), and sometimes the margin of the anus is provided with a pair of curiously curled horns or projections (see von Drasche, Die Synascidien, &c., p. 30, and Taf. xi. fig. 34).

The process of gemmation in the Didemnidæ is very remarkable. Each new Ascidiozooid in the colony arises as two buds which form respectively its thoracic and abdominal regions. The first of these develops from the region of the parent where the thorax and the abdomen join, while the second is formed a little farther back, on the abdomen. The two buds eventually join to form the body of the new Ascidiozooid. This method of budding was termed pyloric by Giard.[1] It has since been more fully investigated by Della Valle.[2] Embryonic budding, or blastogenesis, is not seen so

[1] Recherches sur les Synascidies, *Archives de Zool. expér.*, &c., t. i. p. 576, 1872.
[2] Nuove Contribuzioni, &c., p. 48, 1881.

well in the Didemnidæ as in the allied family Diplosomidæ, in which also pyloric gemmation is found in a very complete condition.

The family Didemnidæ contains only a small number of genera but has a considerable number of species, which are in some cases very difficult to distinguish from one another. Savigny founded the two original genera, *Didemnum* and *Eucœlium*, in 1816.[1] In his second memoir he characterises *Didemnum* as having both apertures of the Ascidiozooid superior (or anterior), the one with six regular lobes and the other irregular or simple; while he places *Eucœlium* in a distinct division, said to have both the apertures superior and simple. In his systematic arrangement, however (pp. 194, 195), he places the two genera close together, and defines them with more detail. The most important distinctions which he points out are that *Eucœlium* forms a thinner and more delicate crust than that of *Didemnum*, and that the branchial aperture in *Eucœlium* is circular and destitute of lobes, while that of *Didemnum* is surrounded by six equal lobes. He describes two species of *Didemnum*, viz., *Didemnum candidum*, and *Didemnum viscosum*, both from the Gulf of Suez; and one species of *Eucœlium*, *Eucœlium hospitiolum*, from the same locality. *Didemnum candidum* and *Eucœlium hospitiolum* are figured (*loc. cit.*, pl. xx.), and from these figures some further distinctive features of Savigny's two genera can be made out. In the external appearance the only noticeable distinction appears to be that the cloacal apertures (which Savigny regarded as being absent, but which are distinctly visible in his figure[2]) are much more obvious in *Eucœlium* than in *Didemnum*. In the minute structure there are several points of distinction. 1. The spicules in the test of *Didemnum* are almost spherical, having merely very slight projections, while those of *Eucœlium* have much larger projections so as to present more of a stellate appearance. 2. The pedicle connecting the branchial and visceral regions of the body is longer in *Didemnum* than in *Eucœlium*. 3. The stomach is on the dorsal side of the intestine in *Eucœlium*, while it is on the ventral side in *Didemnum*. 4. The rectum reaches almost to the anterior end of the branchial sac in *Eucœlium*, while in *Didemnum* it terminates about half-way forwards. 5. As Giard (see below) has pointed out, the mantle in *Eucœlium* is thin and transparent, allowing the branchial sac to show through, while in *Didemnum* it is thick and opaque. 6. *Eucœlium* has a peculiar little swelling upon the posterior part of the intestinal loop behind the stomach which is not found in *Didemnum*. These characters, however, do not apply to all the species of *Didemnum*.

Savigny's two genera, as represented by the type species which he figures, *Didemnum candidum* and *Eucœlium hospitiolum*, seem to be well characterised and sufficiently distinct from one another. Lamarck,[3] however, writing immediately after Savigny, seems to have thought otherwise, as he united the two genera under the one term *Eucœlium*.

[1] Mémoires, p. 64, and Système, pp. 194, 195. [2] *Loc. cit.*, pl. iv. fig. 4. [3] *Hist. Nat.*, &c.

Milne-Edwards,[1] in 1841, formed the genus *Leptoclinum* as an addition to Savigny's two genera, since he found that several species of Didemnidæ which he studied possessed common cloacal cavities which received the atrial apertures of the various Ascidiozooids, a character which Savigny denied to both *Didemnum* and *Eucælium*, although he plainly figures the cloacal apertures in the case of the latter genus. The three genera recognised by Milne-Edwards, *Didemnum*, *Eucælium*, and *Leptoclinum*, form the unistellar division of his Didemniens, the second great group of Compound Ascidians according to his scheme of classification. The genus *Lissoclinum*, founded by Verrill[2] in 1871, requires to be re-examined and fully described before it can be referred to its proper position with certainty. Two species have been placed in the genus, *Lissoclinum aureum* and *Lissoclinum tenerum*, both from the eastern coast of North America.

Giard,[3] in 1872, definitely established the family[4] Didemnidæ as a group including the three genera *Didemnum*, *Eucælium*, and *Leptoclinum*, and distinguished by the possession of calcareous spicules in the common test from their nearest allies the Diplosomidæ. He points out that the cloacal cavities are exceedingly difficult to distinguish in preserved specimens, and that, in all probability, they were present in Savigny's specimens, although not detected by that investigator. Consequently Milne-Edwards' ground for the formation of the genus *Leptoclinum* does not really exist, since all the Didemnidæ have common cloacal cavities. But, as Giard points out, all the species of Didemnidæ examined by Milne-Edwards are characterised by their habit of forming very thin crusts, much thinner than those of *Didemnum*, and consequently the name *Leptoclinum* may still be retained for them, although the distinguishing feature of the genus is not what its founder believed it to be. Giard separates *Eucælium* from *Didemnum* on account of the transparency of the mantle, the obtuse and often rudimentary lobes round the branchial aperture, the length of the rectum, and the swelling on the intestine, all of these being characters which are clearly shown in Savigny's excellent figures. *Eucælium* he distinguishes, on the other hand, from *Leptoclinum* by the thickness of the common test, the presence of the swelling on the intestine, and the form of the cloacal aperture, which is slit-like (as in *Didemnum*) in place of being open and wide as it is in *Leptoclinum*.

Although Della Valle recognised the genus *Leptoclinum* in 1877,[5] and described three new species, he appears to have afterwards abandoned it, as in his later work, in 1881,[6] he divides his section Didemnidi, which is equivalent to the present family, into two genera: —*Didemnum* (or *Tridemnum*), in which there are three rows of stigmata in the

[1] Observations sur les Ascidies Composées, &c.
[2] *Amer. Journ. Sci. and Arts*, ser. 3, vol. i. No. 6, p. 443.
[3] Recherches sur les Synascidies, *Archives d. Zool. expér.*, t. i. p. 644.
[4] He called it a "Tribe" (Tribus I.), *loc. cit.*, p. 644.
[5] Contribuzioni alla Storia Naturale delle Ascidie Composte del Golfo di Napoli, p. 45.
[6] Nuovi Contribuzioni alla Storia Naturale delle Ascidie Composte del Golfo di Napoli, p. 50.

branchial sac, and a well-developed atrial siphon is present; and *Tetradidemnum*, in which there are four rows of stigmata, and the atrial aperture is provided with a languet. This classification appears, however, to refer only to the species which Della Valle was investigating, and which seem from his descriptions and figures to be all referable to the old genus *Didemnum*. Consequently his *Tridídemnum* and *Tetradidemnum* may be regarded as subdivisions of Giard's *Didemnum*.

Von Drasche,[1] in his recent scheme of the classification of the Synascidiæ, does not recognise *Eucœlium*. His family Didemnidæ contains two genera only, which are named *Didemnum*, Giard, and *Leptoclinum*, Milne-Edwards, and he gives as a new distinguishing feature that the former possesses four rows of stigmata while the latter has only three rows.[2] In his large work on the Synascidiæ of the Gulf of Rovigno (1883), von Drasche divides the family into *Didemnum* and *Leptoclinum*, and then subdivides the latter genus into *Leptoclinum* and *Didemnoides;* he rejects the genus *Eucœlium* on the ground that the characters ascribed to it by Savigny and Giard are not sufficient to distinguish it from *Didemnum* and *Leptoclinum*.

If the various classifications referred to above are combined as far as possible, they will form the following scheme, which contains all the subdivisions of the family which have been proposed:—

Family.	Genus.	Subgenus.
Didemnidæ,	*Didemnum.*	*Tridídemnum.*
		Tetradidemnum.
	Eucœlium.	
	Leptoclinum.	*Leptoclinum.*
		Didemnoides.

It is clear, however, that Della Valle's *Tetradidemnum*, with its four rows of stigmata and its atrial languet, is closely allied to von Drasche's *Didemnoides*, and cannot be retained as a subdivision of *Didemnum* if that genus is used in von Drasche's sense.

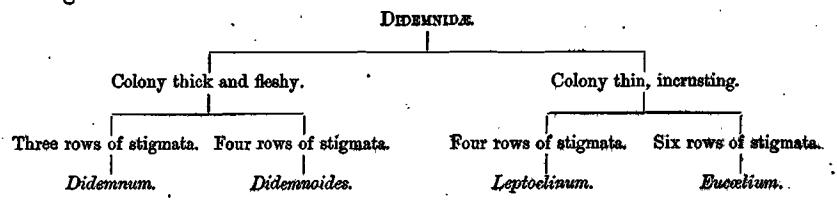
If the number of rows of stigmata is to be regarded as the most important distinguishing feature in the family, then three sections must be recognised, viz., (1) with three rows of stigmata, *Tridídemnum* (or *Didemnum* in the limited sense); (2) with four rows of stigmata, *Tetradidemnum*, *Leptoclinum*, and *Didemnoides;* (3) with six rows of stigmata, *Eucœlium* (see Savigny's figures). *Leptoclinum* and *Didemnoides* may then be separated by the thickness of the colony, leaving *Tetradidemnum* (in regard to which we have not yet sufficient information) with three possibilities before it, viz., (1) it may possibly form thin incrusting colonies, and in that case it should be included in *Leptoclinum*, (2) it may form thick masses and would then be identical with

[1] *Zool. Anzeiger*, 1882, p. 695.

[2] I am inclined to think that he has accidentally misplaced the figures and means the reverse, viz., *Didemnum*, 3, and *Leptoclinum*, 4. See also, Die Synascidien der Bucht von Rovigno, p. 9.

Didemnoides, which would therefore lapse as Della Valle's name has the priority, (3) it may have some peculiarities of its own distinguishing it from both *Leptoclinum* and *Didemnoides*, and necessitating the employment of all three sections. Della Valle's figures and remarks[1] do not decide the matter, and therefore *Tetradidemnum gigas*, Della Valle, must be provisionally placed on one side until more is known in regard to its structure and affinities.

I am not, however, inclined to ascribe very much importance to the number of rows of stigmata, since species differ in that respect which appear to be otherwise closely allied, and I have found in one new species of *Leptoclinum* (see below) three rows and four rows of stigmata present in different Ascidiozooids of the same colony. Consequently, I only use the number of rows as a diagnostic feature in conjunction with other characters, and I regard *Didemnoides* as being quite as closely related to the thick fleshy species of *Didemnum*, although it has four rows of stigmata, as it is to the thin incrusting species of *Leptoclinum*. I therefore divide the family into genera according to the following Table :—



Further remarks as to the affinities of the groups will be found under the generic descriptions.

The species of the Didemnidæ have been described chiefly by Savigny, Milne-Edwards, Giard, Della Valle, and von Drasche. The majority of them belong to the genus *Leptoclinum*, which has a wide distribution, mainly in shallow water.

In the Challenger collection only the two commoner genera *Didemnum* and *Leptoclinum* are with certainty represented, and the majority of the species belong to *Leptoclinum*. The genus *Didemnoides* contains two species found by von Drasche in the Adriatic and on the coast of Normandy. Possibly *Leptoclinum carpenteri*, *Leptoclinum japonicum*, *Leptoclinum jacksoni*, and *Leptoclinum rubicundum*, might be referred to this genus instead of to *Leptoclinum*.

In regard to *Eucœlium*, the only undoubted member of the genus that I know of is Savigny's *Eucœlium hospitiolum*, which differs markedly from all other species of the family in having six rows of stigmata in the branchial sac. Giard's *Eucœlium parasiticum* is probably, as von Drasche supposes, merely a species of *Leptoclinum*. It has only four rows of stigmata in the branchial sac.

[1] Nuove Contribuzioni, &c., p. 50.

Didemnum, Savigny.

Didemnum, Savigny, Mémoires, 1816. In part.
Didemnum, Giard, Recherches, &c., Archives d. Zool. expér., t. i. p. 647, 1872.
Tridídemnum, Della Valle, Nuovi Contribuzione, &c., 1881.
Didemnum, von Drasche, Die Synascidien, &c., 1883.
non *Didemnium*, Kowalevsky, Archiv f. mikrosk. Anat., Bd. x., 1874.

Colony usually thick and fleshy, rarely thin and incrusting.
Ascidiozooids with the atrial aperture on the dorsal edge of the thorax, often placed far back. Atrial siphon lobed or simple. No atrial languet present.
Test gelatinous or cartilaginous, usually not very hard or stiff. Calcareous spicules usually present.
Branchial Sac with three rows of stigmata.

This genus, as formed by Savigny, would include all the Didemnidæ with the exception of *Eucœlium*. Giard, however, has restricted its use by employing Milne-Edwards' genus *Leptoclinum* for the thin incrusting forms and retaining *Didemnum* for the more massive species of the family. It was more fully and correctly characterised recently by von Drasche, and it is used here in the same restricted sense, except that I do not consider the number of rows of stigmata in the branchial sac of so much importance as von Drasche does.

Della Valle's generic title *Tridídemnum* seems unnecessary, and ought to lapse. Sufficient information has not yet been given in regard to his new species *Tridídemnum benda*, but, so far as can be made out from his figures, it seems to agree in all essential points with a typical *Didemnum*. If it should happen to be a species forming a thin incrusting colony, it might be convenient to split up *Didemnum* and apply Della Valle's name *Tridídemnum* to species with thin colonies and three rows of stigmata, while the thicker species would remain under *Didemnum*.

The genus *Didemnum* as used here is characterised by having thick, massive, and usually fleshy colonies in which the test is not so hard and stiff as it is in most species of *Leptoclinum*. Calcareous spicules are as a rule present, but they are not in great abundance throughout the whole test. The ordinary arrangement is that the spicules are numerous in the superficial layers of test, and are scarce or even absent in the deeper parts. In *Didemnum inarmatum*, von Drasche, *Didemnum tortuosum*, von Drasche, and *Didemnum* (?) *inerme*, Herdman (see below, p. 265) there are no spicules present in the test.

The Ascidiozooids are characterised by having the atrial aperture placed far back on the dorsal edge of the thorax in place of being at the anterior end. As a rule there is an atrial siphon, and no atrial languet is present.

I am inclined to regard the possession of only three rows of stigmata as being of less weight than the other two important characters taken together. Therefore if I had to decide upon a species forming a thick massive colony and having Ascidiozooids in which the atrial aperture was placed far back upon the dorsal edge of the thorax and had no atrial languet, I would refer it to the genus *Didemnum*, even if there were four rows of stigmata in the branchial sac.

The three new species which follow may be readily distinguished from one another even by their external appearance, as follows:—

Didemnum savignii is of a chocolate-brown colour, and has few spicules.

Didemnum aurantiacum is of an orange colour, and has many spicules.

Didemnum (?) *inerme* is of a light grey colour, and has no spicules.

It is a little doubtful whether the last one really belongs to this genus, but the other two are typical species of *Didemnum*.

Didemnum savignii, n. sp. (Pl. XXXIV. figs. 1–5).

The Colony is a thick incrusting mass of irregular shape. It is attached by the entire lower surface, which is somewhat concave. The edges are thick and projecting. The upper surface is rather convex; it is even, and quite smooth. The colour is dark brown.

The length is 5·5 cm., the greatest breadth is 3·5 cm., and the thickness is 5 mm.

The Ascidiozooids are of fair size, and are abundant. They are arranged in irregularly rounded systems, and their anterior ends form rounded spots of a yellowish colour on the upper surface of the colony, and generally about 0·5 mm. in diameter. Several common cloacal apertures are visible; they are large and distinct. The bodies of the Ascidiozooids are about 2 mm. in antero-posterior length, and less than 1 mm. in greatest breadth; they are divided into two regions, thorax and abdomen.

The Test is firm and cartilaginous. It is of a dark greyish-brown colour, and is moderately transparent. The matrix is clear and homogeneous. It is densely crowded with bladder cells and small test cells. A few stellate calcareous spicules are present in some places near the upper surface, but they are by no means numerous. Rounded and elongated pigment cells of a brown colour are abundant. They are placed chiefly in the upper part of the colony.

The Mantle is fairly strong and muscular. The muscle bands are mainly longitudinal, and are placed with considerable regularity.

The Branchial Sac is moderately large, and is well developed. There are three rows of large and regularly arranged stigmata on each side. The transverse vessels are provided with muscle fibres.

The Endostyle is very large and conspicuous.

The Dorsal Lamina is represented by a few large languets.

The Dorsal Tubercle has a simple circular aperture.

The Alimentary Canal is moderately large. It forms a long narrow loop. The stomach is globular and smooth walled.

The Reproductive Organs are conspicuous, especially the testis and vas deferens which are of large size in the older Ascidiozooids. They are placed on the intestinal loop. The younger Ascidiozooids only have ova.

Locality.—Doubtful; probably Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47° F.

One large colony of this well-marked species was found in the collection with the label "Station 142 (?)" attached to it. I have named it *Didemnum savignii* in honour of the founder of this and most of the other important genera of the Compound Ascidians.

The colony is of irregular shape (Pl. XXXIV. fig. 1), and was attached by a large area on the lower surface. The edges are, however, free and rounded. The thickness varies from 3 mm. up to nearly 1 cm.: the average is about 5 mm. The colour is a chocolate-brown with a few lighter-coloured areas, and it is marked all over by the yellowish anterior ends of the Ascidiozooids. The systems are compound and very unequal in size. The common cloacal apertures are elliptical slits from 1·5 to 3 mm. in greatest length. They are irregularly placed on the surface (Pl. XXXIV. fig. 1).

The Ascidiozooids are rather long and narrow (Pl. XXXIV. fig. 2). The thorax and abdomen are separated by a very narrow elongated constriction or neck occupied by the œsophagus and the rectum. Narrow retractor muscles spring from the Ascidiozooids and run for a considerable distance through the test.

In its thick massive colony, with conspicuous common cloacal apertures, this species resembles *Leptoclinum maculatum*, Milne-Edwards, of which I have a specimen from the Bay of Naples, measuring as much as 1 cm. in thickness. Such a thickness is unusual in the family Didemnidæ, and especially in the genus *Leptoclinum*. In colour, however, and in some other respects this species differs from *Leptoclinum maculatum*. The Ascidiozooids are placed vertically in the colony, and where the test becomes thickened they only occupy its upper layer.

The test is relatively of large amount. It is firm and moderately tough, and is of a clear dark greyish-brown colour. The bladder cells are large and very abundant, most of them are polygonal from mutual pressure. The test cells are also numerous and conspicuous (Pl. XXXIV. fig. 3). They are coarsely granular. Various shapes occur, but rounded and fusiform ones are the most abundant. The pigment cells are scattered irregularly. In some places they are very abundant and closely placed, while in others they are absent. As a general rule the upper surface of the test is more pigmented than any other part. Most of the pigment cells are rounded, but in some places, close to the surface, they become fusiform and even elongated to a considerable

extent (Pl. XXXIV. fig. 3, *p.c.*). They tend also to become arranged in rows end to end, which gives them a fibrous appearance. They are always brown, and are coarsely granular in texture.

The spicules are stellate and very regular, their rays are tapering and sharp pointed (Pl. XXXIV. fig. 4). A few spherical forms occur. The spicules never reach quite to the external surface, but are separated from it by a layer of test containing bladder cells and pigment cells. Compared with the size of the test the number of spicules present is remarkably small.

The musculature of the mantle is almost entirely longitudinal in direction. A number of rather delicate bands spring from the base of the branchial siphon and spread posteriorly over the thorax. They occasionally give off branches, which unite with neighbouring bands, but nothing like a close network is formed. On the whole these bands run parallel with one another. A few transverse and irregularly running muscles are also present. The branchial siphon is long but narrow (Pl. XXXIV. fig. 2). It is lined by a layer of very dark coloured test, which becomes thickened at the posterior end of the siphon immediately in front of the tentacles. The branchial sphincter is powerful. The aperture is distinctly six-lobed.

The stigmata in the branchial sac are numerous (Pl. XXXIV. fig. 2), and their ciliated cells are very distinct. The muscle bands running along the transverse vessels are strong (Pl. XXXIV. fig. 5, *m.f.*). The endostyle is remarkably wide (Pl. XXXIV. fig. 2, *en.*). Its extremities form thickened projections at the anterior and posterior ends of the branchial sac. The nerve-ganglion is spherical. It is situated at the base of the branchial siphon.

The alimentary canal extends for a considerable distance behind the branchial sac. The œsophagus is very long and narrow (Pl. XXXIV. fig. 2, *œ.*). Its wall is usually thrown into a series of corrugations or slight transverse folds. The stomach is large and thick walled. It is usually ellipsoidal or nearly quadrate in shape, in some cases it is pyriform, the posterior end being narrower than the anterior. Its wall shows no folds or irregular thickenings. The œsophagus and the intestine where they join the stomach are seen in longitudinal sections to project for a short distance into its interior so as to form valvular arrangements (Pl. XXXIV. fig. 2, *st.*). The intestine is long; it extends for a short distance behind the stomach, and then turns anteriorly so as to form a narrow loop. The rectum runs close alongside the œsophagus in the long narrow region of the body which unites the thorax and abdomen (Pl. XXXIV. fig. 2, *r.*). It then runs along the dorsal edge of the branchial sac, and terminates in a small anus placed about halfway down the peribranchial cavity.

The testis is large and of ellipsoidal form. The long conspicuous vas deferens commences by coiling spirally four or five times around the testis (Pl. XXXIV. fig. 2, *v.d.*). A few ova of various sizes were found in some of the smaller Ascidiozooids. Probably

the older ones—after having produced ova in their younger stage—function as males only. Two ova were found far forwards alongside the rectum in the Ascidiozooid figured (Pl. XXXIV. fig. 2, *o.*). No larvæ were discovered in the colony.

Didemnum aurantiacum, n. sp. (Pl. XXXIII. figs. 1–8).

The Colony is a large irregularly convex mass incrusting various foreign bodies. Its upper end is rounded and roughly hemispherical. The lower part is irregular. The surface is even but slightly rough. The colour is an orange-brown.

The length is 4 cm., the greatest breadth is 5 cm., and the thickness is 2·5 cm.

The Ascidiozooids are numerous but very small, and they are placed with great regularity over the surface. They are of rounded form, and the body is not distinctly divided into regions.

The Test is thick and solid. It is firm and opaque. The outer part is of a dull orange colour, while inside it is light grey and semi-transparent. The matrix is apparently structureless. The test cells are abundant and of large size. The spicules are colourless, and are numerous on the surface, but much fewer in number deeper down. They are usually of stellate form, with moderately long rays, but occasionally spherical ones, with very short blunt rays, are met with.

The Mantle is strongly muscular.

The Branchial Sac is small and of rounded form. The stigmata are minute and inconspicuous.

The Endostyle is large and of considerable width. Its course is straight.

Locality.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells.

A single specimen of this species was dredged in Bass' Strait, south of Australia, from a depth of 38 fathoms. It is a handsome colony, roughly of hemispherical form (Pl. XXXIII. fig. 1), and having a dull orange-brown colour, darker in some places and lighter in others.

The Ascidiozooids are placed with great regularity over the surface, where their anterior ends form minute projections from 0·5 mm. to 1 mm. apart (see Pl. XXXIII. fig. 1). There is apparently no arrangement in systems, and no common cloacal apertures are visible in the specimen. The branchial apertures, when viewed from the outer surface (Pl. XXXIII. fig. 3), are usually of an irregularly hexagonal form.

The surface layer of test is stiff and opaque, and contains abundance of spicules (see Pl. XXXIII. fig. 2). These spicules are quite colourless, and although they may aid in producing the opacity of the test, its dull yellow colour is certainly not due to their presence, but is caused by a homogeneous yellow tint in the matrix. The coloured

layer of test is merely a superficial layer or crust, in most places about 1 mm. in thickness. The remainder of the test forms a semi-transparent hyaline mass. Sections of the deeper part of the test show comparatively few spicules (see Pl. XXXIII. fig. 4), while the test cells are abundant, of large size, and vary greatly in shape. Some of them are stellate and have their angles prolonged into processes which connect them with the angles of adjacent cells. Vascular appendages containing muscle fibres are found running vertically through the deeper parts of the test; they form more or less parallel lines (see Pl. XXXIII. fig. 4, *v.ap.*).

The Ascidiozooids are short, and are more or less rounded in form. Their branchial apertures, when examined from the interior, are found to be small and rather variable in shape. Usually they are rounded or irregularly hexagonal, but they may be stellate (probably the result of contraction), and in the example figured (Pl. XXXIII. fig. 5) the aperture is distinctly triradiate, its margin having three well-marked lobes. The sphincter muscle (*sph.*) surrounding the branchial aperture is strong, and from its outer edge a number of radiating bands arise and run posteriorly over the body, forming the longitudinal muscles of the mantle.

The test immediately around the branchial aperture is in some cases free from spicules (Pl. XXXIII. fig. 5), and consequently forms a circular lighter-coloured area representing the anterior end of the Ascidiozooid; but in other specimens the spicules extend up to the edges of the aperture (Pl. XXXIII. fig. 3, *sp.*). The commonest form of spicule in the test is seen highly magnified at Plate XXXIII. figure 6, *a*. Spicules with narrower and more sharply pointed rays are also found, and more rarely spherical forms with short blunt projections occur (see Pl. XXXIII. fig. 6).

The alimentary canal forms a short open loop. The stomach is small and of rounded form. The testis is very large, and the vas deferens form a number of close spiral coils around it (Pl. XXXIII. fig. 7).

A number of fully-developed tailed larvæ were found imbedded in the common test. They are of very large size, usually larger than the Ascidiozooids, and have two distinct pigmented sense organs (see Pl. XXXIII. fig. 8).

Didemnum (?) *inerme*, n. sp. (Pl. XXXIV. figs. 6, 7).

The Colony is a rounded mass attached by the greater part of its lower half. The upper surface is convex and quite smooth. The colour is a dull grey.

The length is 1·2 cm., the greatest breadth is 1·5 cm., and the greatest thickness is 1·3 cm.

The Ascidiozooids are apparently small and not very numerous. They are scattered irregularly in the upper layer of the colony, and seem not to be arranged in definite systems. No common cloacal apertures are visible.

The Test is firm and cartilaginous. It is of a grey colour, and is semi-transparent. The matrix is clear and structureless. It contains minute inconspicuous test cells, and a considerable number of large bladder cells, but no calcareous spicules are present.

Locality.—Off Bermuda, shallow water.

This is a colony of compact rounded form which was dredged off Bermuda in shallow water (Pl. XXXIV. fig. 6). It is unlike any other species in the collection, and is, I think, distinct from any known species of Compound Ascidian; but unfortunately, on account of the condition of the Ascidiozooids in the single colony at my disposal, it is impossible to give a complete specific description, or even to refer the specimen to its proper genus with certainty. All the Ascidiozooids are apparently in a decomposed condition; they are found on examination to be merely rounded or elongated masses of granular débris. Probably the colony was dead and in a decaying condition when collected.

It is simply from the general appearance, and not from any structural feature, that I place this specimen in the Didemnidæ, but it is quite possible that it may really belong to the Polyclinidæ. If, however, it is correctly placed in the present family, then, on account of its massive form (Pl. XXXIV. fig. 6), there can be little doubt that its genus is *Didemnum* or *Didemnoides*. As the former is the commoner and more widely distributed genus, I have provisionally placed the species there.

The test, as is usual in Compound Ascidians, even when the Ascidiozooids are dead, is in good condition, but no spicules are present. This, although unusual in the Didemnidæ, is not an unknown condition, as von Drasche's two species, *Didemnum inarmatum* and *Didemnum tortuosum*,[1] have no spicules in the test.

The bladder cells are large and fairly numerous (Pl. XXXIV. fig. 7, *bl.*). They are of the usual ellipsoidal form, with distinct laterally placed nuclei. The test cells are of various shapes, but are all of small size (Pl. XXXIV. fig. 7, *t.c.*).

Leptoclinum, Milne-Edwards.

Leptoclinum, Milne-Edwards, Observations sur les Ascidies Composées, 1841.
Leptoclinum, Giard, Recherches sur les Synascidies, &c., Archives d. Zool. expér., t. i. p. 651, 1872.
Leptoclinum, Della Valle, Contribuzioni, &c., 1877.
Leptoclinum, von Drasche, Die Synascidien, &c., p. 33, 1883 (as a subgenus).

Colony forming a thin incrusting layer, rarely thick and massive.
Ascidiozooids with the atrial aperture on or near the anterior end of the body, and provided with a long languet.
Test very hard and firm, densely crowded with calcareous spicules.
Branchial Sac usually with four rows of stigmata.

[1] Die Synascidien der Bucht von Rovigno, p. 32, 1883.

This genus was first instituted by H. Milne-Edwards under the impression that Savigny's Didemnidæ has no common cloacal cavities, while the species which he found living on the French coast had. As all the members of the family probably agree in having more or less well-developed common cloacal cavities and apertures, Milne-Edwards' genus was really unnecessary, but it has been retained for a section of the old genus *Didemnum*, and now includes those species which form thin incrusting colonies, with a hard test stiffened by the presence of numerous calcareous spicules. In using the name in this sense von Drasche considers it as forming only a subgenus with *Didemnoides* as its companion group, but I feel convinced that *Leptoclinum* and *Didemnoides* are as distinct from one another as either is from *Didemnum*, and therefore I regard the three groups as being genera of equal rank.

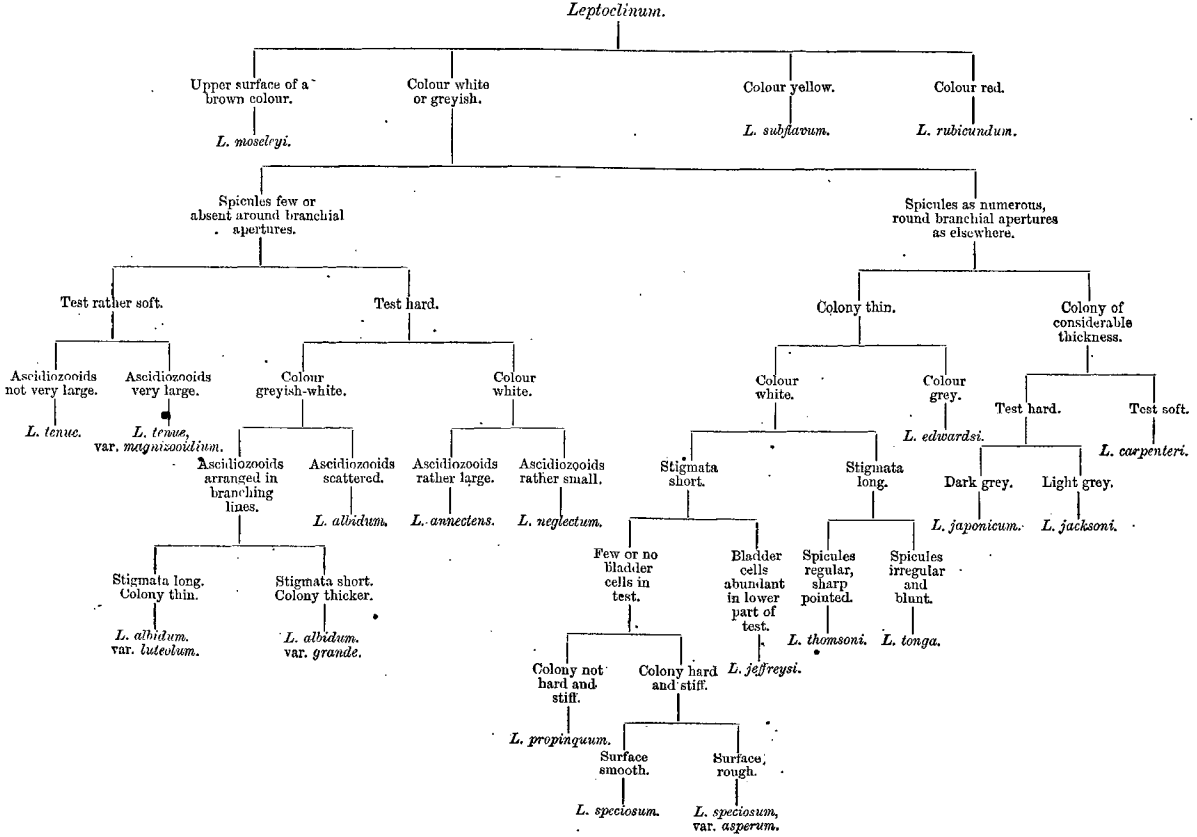
In *Leptoclinum* the Ascidiozooids have the atrial apertures placed near the anterior end of the body, and usually provided with long atrial languets. They never have simple atrial siphons like those of *Didemnum*.

The branchial sac in *Leptoclinum* has usually four rows of stigmata, but this is not an invariable characteristic, as in *Leptoclinum thomsoni* I have found that some of the Ascidiozooids in the colony have four rows, while one at least has only three, and in *Leptoclinum propinquum* there are apparently only three rows of stigmata, and yet, as I shall point out in the description of that form, I cannot regard it as being a species of *Didemnum*. On the other hand, in *Leptoclinum edwardsi* five rows of stigmata were found in one of the Ascidiozooids examined, thus showing an approach to the condition characteristic of *Eucœlium*.

The relations of the alimentary canal to the branchial sac may vary considerably in the genus. In most cases there is a distinct abdomen which extends beyond the thorax posteriorly, but in *Leptoclinum moseleyi* the alimentary canal lies on the dorsal edge of the branchial sac, and the body of the Ascidiozooid is short. This is probably a modification produced by the thin condition of the colony.

A large number of species of *Leptoclinum* have been described, chiefly by Milne-Edwards, Giard, Della Valle, and von Drasche. It is extremely difficult to distinguish some of these species, especially in the case of spirit specimens, where the natural colour is lost. I believe, however, that I am right in considering that all the Challenger specimens of this genus belong to species previously unknown to science, with the exception of those which I have referred to *Leptoclinum albidum*, Verrill, and its variety *luteolum*. It is possible that *Leptoclinum jacksoni* and two or three of the other more massive species should be removed from this genus and placed under *Diplosomoides*.

The various species and varieties of *Leptoclinum* in the collection may be distinguished shortly by the following characters:—


Leptoclinum.
Upper surface of a brown colour.
L. moseleyi.
Colour white or greyish.
Colour yellow.
L. subflavum.
Colour red.
L. rubicundum.
Spicules few or absent around branchial apertures.
Spicules as numerous, round branchial apertures as elsewhere.
Test rather soft.
Test hard.
Ascidiozooids not very large.
L. tenue.
Ascidiozooids very large.
L. tenue, var. magnizooidium.
Colour greyish-white.
Colour white.
Ascidiozooids arranged in branching lines.
Ascidiozooids scattered.
L. albidum.
Ascidiozooids rather large.
L. annectens.
Ascidiozooids rather small.
L. neglectum.
Stigmata long. Colony thin.
L. albidum. var. luteolum.
Stigmata short. Colony thicker.
L. albidum. var. grande.
Colony thin.
Colony of considerable thickness.
Colour white.
Colour grey.
L. edwardsi.
Test hard.
Test soft.
L. carpenteri.
Stigmata short.
Stigmata long.
Dark grey.
Light grey.
L. japonicum.
L. jacksoni.
Few or no bladder cells in test.
Bladder cells abundant in lower part of test.
Spicules regular, sharp pointed.
Spicules irregular and blunt.
L. thomsoni.
L. tonga.
L. jeffreysi.
Colony not hard and stiff.
Colony hard and stiff.
L. propinquum.
Surface smooth.
Surface rough.
L. speciosum.
L. speciosum, var. asperum.

Some of these forms are very closely related to one another. It should be remembered that all the specimens in the collection have been preserved in alcohol, and that some of the species, which are now all of a dull greyish-white tint, may have been distinguishable from one another by their diverse colours when living.

Leptoclinum tonga, n. sp. (Pl. XXXV. figs. 1–10).

The Colony is an irregularly shaped flat expansion, slightly thickened at the edges and attached by the greater part of the lower surface. It is of a pure white colour and is quite opaque. The upper surface is uneven but smooth.

The length is about 6 cm., the greatest breadth is about 3 cm., and the average thickness is 3 mm.

The Ascidiozooids are small and not numerous. Their anterior ends are visible as minute depressions on the surface, which are arranged in irregular branching lines. No common cloacal apertures are visible.

The Test is solid, firm, and tough. It is opaque, and of a white colour throughout. The matrix is homogeneous; it contains a few small fusiform and branched test cells and a very large number of calcareous spicules. The spicules are irregularly stellate, with the rays usually uneven and blunt at the apex.

The Mantle is moderately strong. The branchial sphincter is well developed.

The Branchial Sac is fairly large. There are four rows of long narrow stigmata.

The Endostyle is large and conspicuous. Its course is straight

The Dorsal Lamina is represented by a series of long tapering languets.

The Tentacles are large and rather numerous. They are of two sizes, but are not arranged with perfect regularity.

Locality.—Station 172, off Tongatabu, Friendly Islands, July 22, 1874; lat. 20° 58′ S., long. 175° 9′ E.; depth, 18 fathoms; bottom, coral mud.

This is a flat incrusting species of a pure white colour. One irregularly shaped colony (Pl. XXXV. fig. 1) was obtained off the island of Tongatabu in the South Pacific, from a depth of 18 fathoms. It was evidently not attached by the whole of the lower surface, as the edges are thickened and turned upwards, forming rounded projecting margins. The lines produced on the upper surface by the branchial apertures of the Ascidiozooids form an irregular network (see Pl. XXXV. fig. 1), the meshes of which project as rounded masses of test. The edges and some other parts of the colony are formed of test only, the Ascidiozooids being by no means numerous. The thickness of the colony varies from about 1 mm. to 4 or 5 mm. The lower surface by which the colony was attached is very finely roughened, and is seen in sections to be produced into shorter and longer adhering processes of the test containing each a few spicules (see Pl. XXXV. fig. 3, *ad.*, which represents part of the lower surface cut in vertical section).

The test is large in amount relatively to the size of the colony, and it is rather hard and quite opaque. The test cells are few in number. They are seen best in the layer of test which forms the upper surface of the colony (Pl. XXXV. fig. 2, *t.m.*), and which is in most places free from spicules. The test cells are mostly fusiform, and are placed with their long axes parallel to the surface.

The spicules are very abundant, but not large. The general form is stellate (Pl. XXXV. figs. 2, 3, *sp.*), but they are characterised by their irregularity. The rays are of unequal length, and are frequently as thick near the apex as at the base, or even thicker (Pl. XXXV. fig. 4). In some cases smaller spicules with very short rounded rays, or having merely a knobbed spherical form, are seen (Pl. XXXV. fig. 4).

As this species, on account of the comparatively simple structure of the test, and the large number of very distinct spicules present, seemed to be a favourable object for an investigation into the relation between the calcareous spicules and the surrounding test matrix and the mode of formation of the spicules, I cut a large number of thin sections and examined them after various methods of treatment, with the following results :—

When a section of the test is treated, under the microscope, with a drop of hydrochloric acid, the spicules are seen to be dissolved out with effervescence, and after a short time they competely disappear, leaving a large number of rounded or polygonal vacuoles in the test (Pl. XXXV. fig. 10) which were not visible before. In many of these vacuoles distinct thickenings are seen at the angles, and in some cases the angles are produced outwards to form a rudely stellate figure (Pl. XXXV. fig. 10,—notice the vacuoles marked 1, 2, 3).

When a specimen prepared in this manner is stained with aniline blue solution a delicate membrane bounding the vacuole is brought into view by its taking on the stain more deeply than the surrounding test matrix, and the angular points, which were just visible before, now appear as distinct thickenings on this membrane (see Pl. XXXV. fig. 5).

When a small piece of the test is teased (before decalcification) so as to release some of the spicules, and these are then stained in aniline blue, in some cases a delicate membrane enclosing the spicule can be made out. It is seen best where it stretches across from one ray of the spicule to the adjacent one, as it sometimes does without dipping completely into the angle between (see Pl. XXXV. figs. 8, 9).

When a section of the test is treated with very dilute hydrochloric acid, which is washed off when the spicules are only partially solved, and is then stained in aniline blue or in eosine, spicules in all stages of solution are found, and they are seen to lie each in one of the rounded or polygonal vacuoles which have made their appearance, and the outlines of which are distinctly stained, and it is also now seen that the thickened angles of the vacuoles correspond to the apices of the rays of the contained spicules (see Pl. XXXV. fig. 7, 1 and 2).

If a thin section is soaked for from six to twenty-four hours in water saturated with carbon dioxide, it is found that the spicules are either entirely dissolved out or only partially so, according to the length of the treatment. Their remains when visible are always found inside the large spherical or polygonal vacuoles, the boundaries of which stain readily with eosine or aniline blue, and more faintly with picrocarmine. In a few cases after the treatment with carbon dioxide the vacuole was distinctly stellate in form, and not very far outside the rays of the partially dissolved spicule.

The chief difference between the sections decalcified by means of carbon dioxide and those treated with hydrochloric acid was that in the former, in nearly all cases, the more or less stellate membrane which had apparently been attached to the spicule, and was set free by its dissolution, lay distinctly inside the margin of the vacuole (see Pl. XXXV. fig. 6, where 1 shows the margin of the vacuole, and 2 the stellate membrane inside which the spicule lay).

These results seem to indicate that the calcareous spicule is formed by a group of modified test cells, which constitute, when the spicule has attained a fair size, its membranous investment.[1] Possibly the angular thickenings, which stain more deeply than the rest (see Pl. XXXV. fig. 5), may be the nuclei or the protoplasmic remains of the constituent cells. This membrane is apparently in the natural condition in close contact with the test matrix externally, and with the spicule internally, with the exception of occasional small chinks at the bases of the rays in some specimens (Pl. XXXV. figs. 8, 9). Slow decalcification with carbon dioxide sets it free from both test matrix and spicule (Pl. XXXV. fig. 6), while the more rapid action of hydrochloric acid causes the membrane to assume a polygonal or spherical form, and seems to press it outwards against the bounding test matrix (Pl. XXXV. figs. 5, 7, 10), probably as a result of the evolution of carbon dioxide. It is not, however, evident to me why, after treatment with water saturated with carbon dioxide, the vacuole in the test matrix should assume a more or less spherical form (Pl. XXXV. fig. 6), as in this case no gas is evolved.

The branchial sphincter and the muscular system generally are well developed. The invaginated test lining the branchial siphon is distinctly visible in the vertical sections (see Pl. XXXV. fig. 2, *br.*) and contains a number of calcareous spicules. A few longitudinal muscle bands start from the posterior end of the branchial sphincter and radiate outwards over the anterior part of the body.

The stigmata in the branchial sac are notable for their considerable length. The ciliated cells are distinct, and are pointed at the free ends. The tentacles are very distinctly of two sizes (Pl. XXXV. fig. 2, *tn.* and *tn'.*), which as a general rule are placed alternately.

[1] The observations which were made on the test and the discoid spicules of the genus *Cystodytes* point to a similar process of formation (see p. 139).

Leptoclinum moseleyi, n. sp. (Pl. XXXVII. figs. 9–14).

The Colony is a flat incrusting expansion of irregular shape. It is attached by a considerable portion of the lower surface, but the edges are free, slightly projecting, and corrugated in places. The colour is white on the lower surface, and brownish on the upper. The surface is even and moderately smooth.

The length is 5·3 cm., the greatest breadth is about 2 cm., and the thickness is 1 to 2 mm.

The Ascidiozooids are fairly numerous, and are of moderate size. They are distributed evenly over the upper surface of the colony, and no common cloacal apertures are visible. The bodies of the Ascidiozooids are placed mainly at right angles to the surface, and are divided distinctly into two regions, thorax and abdomen.

The Test is not large in amount, but is exceedingly hard and stiff. It consists of a clear homogeneous matrix, in which are imbedded a few small test cells and a very large number of calcareous spicules. The test matrix in the lower part of the colony is almost entirely occupied by the spicules, and in that region no test cells are visible. The spicules are mostly stellate in form, and are of fairly large size. The size and shape of the rays vary considerably in different spicules.

The Mantle is moderately thick and muscular. The branchial sphincter is particularly strong. The retractor muscles are well developed.

The Branchial Sac is very large. It has four rows of well developed stigmata arranged with regularity.

The Dorsal Lamina is represented by a series of very large triangular languets.

The Tentacles are of two sizes, the larger of which is rather long. They are placed alternately.

The Alimentary Canal is relatively of small size. It lies on the dorsal side of the posterior end of the thorax.

Locality.—Samboangan, Philippine Islands; depth, 10 fathoms.

One colony of this very remarkable species was obtained off Samboangan in the Philippine Islands, from shallow water. It is probably the most thoroughly calcareous species that is known.

The colony forms an elongated expansion of irregular form (see Pl. XXXVII. fig. 9), attached by the greater part of the lower surface, and having the edges free and projecting. The upper surface is rather depressed in the centre, and some of the corrugations of the margin curl slightly over it. The lower surface is flat, and is of a dull white colour. The upper surface varies in colour from white to dark brown (Pl. XXXVII. fig. 9). The greater part of it is of a yellowish-brown or fawn colour. The rounded edges are always white.

The Ascidiozooids are visible all over the upper surface of the colony, except on the projecting margin. Their branchial apertures form minute depressions which show as dark dots (Pl. XXXVII. fig. 9). The thorax is very much larger than the abdomen, and is placed vertically in the colony (Pl. XXXVII. fig. 10). It usually extends about three-fourths of the way across from the upper to the lower surface. The abdomen does not extend behind the thorax, but lies at right angles to it on the dorsal edge (see Pl. XXXVII. fig. 10). This condition of parts is not at all related to that found in the family Botryllidæ, where the abdomen is also placed alongside the thorax in place of extending behind it. In the present species, and some other Didemnidæ, the abnormal position of the abdomen has probably been produced by the thinness of the colony, which must have been derived from a much thicker mass, and then became gradually converted into an incrusting film. As the colony became thinner and thinner, the Ascidiozooid would gradually come to have the abdomen bent at a greater and greater angle to the original antero-posterior axis of the body, until it reached the extreme condition found in the present species, where it does not extend beyond the posterior end of the thorax, but runs outwards at right angles to it. Any further bending after this angle had been reached would be of no advantage.

In the Botryllidæ, the alimentary canal lies on one side of the body, not on the dorsal edge, and is, moreover, placed close alongside the branchial sac, so as to be covered by the same layer of mantle. In the present species, on the other hand, the alimentary canal is widely separated from the thorax, not only by the mantle, but also by a large projection of the common test which lies in the angle between the œsophagus and the posterior end of the dorsal edge of the branchial sac (Pl. XXXVII. fig. 10).

The test is so hard and brittle that it feels like a layer of solid calcareous matter. Sections show that it is very full of spicules, which are specially abundant on the lower surface of the colony (Pl. XXXVII. fig. 10, *l.s.*), and form a very dense band in which no test matrix is visible. The spicules are more closely placed in this region of the colony than in any other Leptoclinid which I have examined. The part of the test where the spicules are least crowded is the central layer, and they gradually become denser as either surface is approached. On the upper surface, however, they are not nearly so abundant as on the lower (Pl. XXXVII. fig. 10).

In the central layer of the colony the test cells and the individual spicules are most clearly seen (Pl. XXXVII. fig. 11). The test cells (*t.c.*) are small and are generally rounded or fusiform; a few of them have developed small vacuoles, but no true bladder cells are present. The spicules vary greatly in shape. Some are of the regular stellate form, with tapering rays and sharp apices (Pl. XXXVII. fig. 11, *sp'*), while others have the rays thicker and blunter. In many cases the rays are reduced to rounded knobs (Pl. XXXVII. fig. 11, *sp.*), so that the spicule as a whole may become a mammilated sphere. A few of the spicules are asymmetrical, and have one half of the surface

provided with tapering rays, while the other half has rounded knobs (see Pl. XXXVII. fig. 11, *sp''*). As a general rule the spicules close to the surfaces of the colony are sharper, while those in the deeper parts are blunter, but there are exceptions.

The branchial siphon is very large. It is lined by a thick layer of test containing spicules (Pl. XXXVII. fig. 10, *br.*, and 12, *t.* and *sp.*). The sphincter is of very large size (*sph.*). At its posterior edge on each side a strong band of muscle fibres arises which runs downwards over the thorax near its dorsal edge (Pl. XXXVII. fig. 10), and crosses the œsophagus (Pl. XXXVII. fig. 13, *m.b.*) to be inserted into the test below the abdomen, and near to the lower surface of the colony. Just after crossing the œsophagus, the muscle band is joined by a smaller bundle of fibres which arises from the mantle over the posterior extremity of the endostyle (Pl. XXXVII. fig. 13). This is in all probability, like the corresponding bands in *Leptoclinum thomsoni*, and those described by von Drasche in the case of *Didemnoides macroophorum*, a system of retractor muscles.

The branchial sac is particularly large (Pl. XXXVII. fig. 10). It is longer antero-posteriorly than dorso-ventrally. The three transverse vessels separating the rows of stigmata are moderately wide; they are all of the same size, and are provided with bands of muscle fibres (Pl. XXXVII. fig. 14, *tr.*). The stigmatic cells are distinct and regular.

The endostyle is very large and conspicuous (Pl. XXXVII. fig. 10). The dorsal languets are larger than the tentacles. They extend nearly to the endostyle across the branchial sac (Pl. XXXVII. fig. 10). Their bases are united by a band of muscle fibres which runs along the median dorsal line of the thorax. The tentacles are fairly numerous (Pl. XXXVII. fig. 10). The smaller ones are liable to a certain amount of variation in number and arrangement.

The œsophagus runs dorsally from the posterior end of the dorsal edge of the branchial sac. It varies somewhat in calibre (Pl. XXXVII. fig. 10). The stomach lies in the same straight line with the thorax, and is elongated dorso-ventrally. It is not large, and its walls show no ridges nor other thickenings. They are lined by long columnar cells (Pl. XXXVII. fig. 10). No reproductive organs were found in any of the Ascidiozooids examined.

Leptoclinum speciosum, n. sp. (Pl. XXXVI. figs. 1–8).

The Colony is a flat expanded mass of considerable size. It is thin and incrusting, and is attached by the whole of the lower surface. The upper surface is even, and perfectly smooth. The colour is pure snow white.

The length is about 5 cm., the breadth is 4·5 cm., and the general thickness is about 2 mm.

The Ascidiozooids are numerous and of fair size. They are closely placed all over the upper surface of the colony. They are not arranged in definite systems, but common

cloacal apertures of small size, and surrounded by six lobes, occur frequently over the surface of the colony. The bodies of the Ascidiozooids are placed vertically in the colony, and are distinctly divided into two regions, thorax and abdomen.

The Test is hard and brittle. It is white, and is opaque throughout. The matrix is structureless, and contains large numbers of calcareous spicules and of test cells. The latter are mostly fusiform, or triangular in shape. The spicules are stellate or spherical. They vary somewhat in size and shape. Vessels with swollen ends also occur in the test; they are not numerous, but they occasionally branch near their terminations.

The Mantle is thin and membranous. The musculature is feeble.

The Branchial Sac is small, but the stigmata are well developed. There are four rows, separated by wide tranverse vessels. The stigmata are short but regular.

The Endostyle is large and conspicuous.

The Alimentary Canal is of considerable size. It forms a narrow loop placed behind the branchial sac.

The Reproductive Organs are placed alongside the intestine. The testis is large, and the vas deferens is spirally coiled around it.

Locality.—Bahia, Brazil, September, 1873; depth, 7 to 20 fathoms.

One large colony and several smaller ones of this handsome species were obtained in shallow water off Bahia, on the east coast of South America. They incrust Sponges (Pl. XXXVI. fig. 1) and other foreign bodies.

In most cases the colony is a thin expansion attached throughout its entire extent, but in some of the smaller colonies some parts become thickened and form projecting lobes (Pl. XXXVI. fig. 3 shows a section through such a thickened knob). The surface is always smooth and of a pure opaque white colour. The dimensions given above are those of the large colony. The other specimens in the collection are all considerably smaller.

The Ascidozooids are distributed evenly over the surface of the colony, and their anterior ends show distinctly as small circular dots (Pl. XXXVI. fig. 1). The common cloacal apertures are numerous but of very small size. Slight magnification with a lens allows the lobes surrounding both the branchial and the common cloacal apertures to be distinctly seen (Pl. XXXVI. fig. 2, *br.* and *at.*). In both cases there are six, and they are triangular in form, consequently the closed apertures have a stellate appearance.

The abdomen of the Ascidizooid lies nearly directly behind the thorax, and is about equal to it in size (Pl. XXXVI. fig. 3). It extends from one-half to three-fourths of the way from the upper to the lower surface of the colony, except in places where the test is especially thick (Pl. XXXVI. figs. 8 and 3). In such cases the thickening is in the test below the posterior ends of the Ascidiozooids.

The test is not tough. It is hard and white all though, but the spicules are more abundant near the upper surface than elsewhere (Pl. XXXVI. figs. 3, 8). A section through the test in the middle of the colony shows (Pl. XXXVI. fig. 4) the homogeneous matrix, the test cells, the spicules, and the ectodermal vascular appendages of the Ascidiozooids. The ectodermal appendages (or vessels) are specially noteworthy in the present species on account of their exhibiting branching (Pl. XXXVI. figs. 4, 8), a feature which has not been previously noticed, I think, in any of the Leptoclinidæ. The terminations of the vessels are swollen to form ovate bulbs covered with thickened epithelium (Pl. XXXVI. fig. 4, *t. k.*). A few muscle fibres are found in some of the vessels, but the musculature is not so well developed as in some other species of the Leptoclinidæ. A few small bladder cells are found in this test (Pl. XXXVI. fig. 4, *bl.*), but they are inconspicuous, and in most cases are not so large as the spicules. The ordinary test cells are rather large. Near the surfaces they are elongated in form and lie with the long axis parallel to the surface. The spicules vary considerably in shape. Some, and they are generally the smaller ones, are simple spheres, others are spherical with mammillated or knobbed surfaces (Pl. XXXVI. fig. 4, *sp.*), while the larger spicules are stellate with spherical centres and a number of projecting rays with, in most cases, sharp apices. The spicules are generally very regular, but a few deformed or monstrous forms may be seen.

The branchial siphon is large (Pl. XXXVI. figs. 3, 8, *br.*) and its sphincter is very well developed, but over the mantle generally the musculature is feeble (Pl. XXXVI. fig. 6, *m.b.*). The ectoderm on its outer surface is in some places very distinct, the outlines of the polygonal cells and their central nuclei being clearly visible (Pl. XXXVI. fig. 5). The branchial siphon has a thick lining of test in which spicules are present (Pl. XXXVI. fig. 8, *br.*).

The branchial sac is longer antero-posteriorly than dorso-ventrally. It is of ovate form (Pl. XXXVI. fig. 3). The transverse vessels are wide, and are all of the same size (Pl. XXXVI. fig. 8).

The œsophagus runs directly backwards from the posterior end of the branchial sac to open into the large ovate stomach which is placed with its long axis antero-posteriorly.

The wall of the stomach shows no ridges externally, but is produced internally into four longitudinal pads so as to reduce the lumen to an ×-shaped slit (see Pl. XXXVI. fig. 8, left side of figure). Where the œsophagus and the intestine join the stomach at its anterior and posterior ends these tubes are produced inwards for short distances so as to form valvular arrangements (Pl. XXXVI. fig. 8). The intestine is narrow. It runs posteriorly for a short distance from the stomach, and then turns forwards so as to run alongside the stomach and œsophagus, forming a short loop. Various parts of its course are seen in the sections represented in figures 3 and 8.

The large ovate testis lies alongside the intestinal loop, and the vas deferens

commences by coiling six or seven times around it (Pl. XXXVI. fig. 8, *t.v.*). Figure 7 on Plate XXXVI. shows a section through the testis (*t.v.*) with some of the coils of the vas deferens (*v.d.*) on its surface. No ova and no embryos nor larvæ were found in any of the Ascidiozooids examined.

Leptoclinum speciosum var. *asperum*, nov. (Pl. XXXIV. figs. 8–13, and Pl. XXXVI. fig. 9).

The Colony is a thin incrusting layer of irregular shape, attached by its whole extent. The upper surface is somewhat uneven, and it is rough all over. The colour is white.

The length is about 5 cm., the breadth about 3 cm., and the thickness from 1 to 2 mm.

The Ascidiozooids are numerous and fairly large. They are closely placed all over the surface of the colony. Some cloacal apertures are present here and there, but no definite systems are visible. The Ascidiozooids are elongated antero-posteriorly, and are placed vertically in the colony. The thorax and abdomen are distinctly separated.

The Test is hard and brittle. It is opaque white throughout. The matrix contains small test cells, numerous calcareous spicules, and, in the superficial layer, a few bladder cells. The spicules are stellate, of regular form, and of considerable size. Ectodermal prolongations from the Ascidiozooids are also met with in the test.

The Mantle is moderately thick and muscular, the branchial sphincter is powerful, and retractor muscles are present.

The Branchial Sac is small. There are four rows of short stigmata, and the transverse vessels between them are wide.

The Endostyle is wide and conspicuous. It undulates greatly from side to side in its course.

The Dorsal Lamina is represented by a series of long narrow languets.

The Tentacles are large. They are sixteen in number, and are of two sizes, placed alternately.

The Alimentary Canal is large. It forms a long narrow loop behind the branchial sac.

Localities.—(*a.*) Bahia, Brazil, September 1873; depth, 7 to 20 fathoms. (*b.*) Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom, green sand; bottom temperature 47° F.

Several colonies obtained in shallow water off Bahia, on the east coast of South America, form a very distinct variety. In external appearance they differ markedly from the typical forms of the species, found in the same locality, in having the surface finely roughened all over in place of being smooth. As the internal structure also differs somewhat in the two forms, it is doubtful whether it might not be better to

regard them as distinct species. The specimens from Station 142 are, however, intermediate in some of their characters.

The shape of the colony varies with that of the object to which it is attached. The largest colony (the dimensions of which are given above) has grown over the surface of a Sponge and some other objects, and its form is most irregular (Pl. XXXIV. fig. 8); while some of the smaller colonies are attached to the branches of a Plumularian Zoophyte, around which they have grown in such a way as to form nearly regular cylinders (Pl. XXXVI. fig. 9). One of the smaller colonies on the Zoophyte is, however, quite irregular in form (Pl. XXXVI. fig. 9, left side of figure). The colour is not quite such a pure white as in the case of *Leptoclinum speciosum*, but this is probably the result of the roughness of the surface.

In number, size, distribution, and position in the test, the Ascidiozooids resemble those of the typical specimens of *Leptoclinum speciosum*. The common cloacal apertures are also similar to those of that species, but are not quite so numerous. As in *Leptoclinum speciosum*, both the branchial apertures and the common cloacal apertures are surrounded by six triangular lobes.

The bodies of the Ascidiozooids are considerably elongated antero-posteriorly (Pl. XXXIV. fig. 9), and the abdomen is longer than the thorax. The posterior end of the Ascidiozooid does not reach to the lower surface of the colony.

As in the case of *Leptoclinum speciosum* the spicules in the test are more abundant near the upper surface than elsewhere. They are, however, fairly numerous in all parts. A vertical section through the colony (Pl. XXXIV. fig. 9) shows that the cause of the roughness on the upper surface is the presence of a number of short spine-like projections from the surface of the test. These are formed of test matrix containing numbers of sharply pointed spicules which are developed close up to the surface of the test (see Pl. XXXIV. figs. 9, 10). In the spaces between these pointed projections, the surface layer of test is for a short distance generally free from spicules, and is on the other hand occupied by large bladder cells (Pl. XXXIV. fig. 10, *bl.*). The bladder cells are, as a rule, only one row deep, and are placed closely side by side. They are polygonal or ellipsoidal in shape from mutual pressure, and are usually elongated at right angles to the surface of the colony. The test cells are small and not very abundant; they are mostly of rounded or fusiform shapes (Pl. XXXIV. fig. 10). The matrix shows in some places a delicate fibrillation.

The spicules are more than usually regular (Pl. XXXIV. fig. 10, *sp.*). The rays are long and pointed, and spherical or mammillated forms are very rarely met with. In an optical section, through the centre, the spicule has the appearance shown in figure 11, where each ray is seen to be continued into the centre of the spicule in the form of a short wedge. There is a tendency for the spicule to break up along the lines separating the wedges, so as to produce pieces having the form shown in figure 12. Consequently

the spicule seems to be built up of a number of short wedges or cones joined by their apices, and having the bases prolonged into tapering rays.[1]

The muscle bands in the mantle are delicate but very numerous. They run longitudinally, transversely, and irregularly, and form a close network over the thorax. The branchial siphon is very large, in some cases nearly as large as the branchial sac. It is lined by test containing a number of spicules (Pl. XXXIV. fig. 9, *br.*). The branchial sphincter is large, and it gives rise at its posterior edge to a strong retractor muscle on each side, which runs backwards over the thorax near the dorsal edge, and, after joining a smaller muscle band from the mantle in the neighbourhood of the posterior extremity of the endostyle, runs outwards into the test for a considerable distance. This retractor muscle is, when in the test, a tubular prolongation of the mantle; it may be regarded as a vascular appendage from the Ascidiozooid, in the walls of which muscle fibres have been developed.

The branchial sac is a small ovate organ (Pl. XXXIV. fig. 9) with rather thick walls and small stigmata. The endostyle is especially large. The dorsal languets are long, and are tentacular in shape; there is one on each transverse vessel. The tentacles are rather larger than is usual in the Didemnidæ (see Pl. XXXIV. fig. 13). There are eight larger and eight smaller placed alternately.

The œsophagus leads directly backwards from the posterior end of the small branchial sac to the rather large stomach (Pl. XXXIV. fig. 9). The shape of the stomach is ellipsoidal, and its outer wall is smooth. Several longitudinal thickenings formed of long columnar cells project into the lumen. The intestine is very similar in appearance and course to that of *Leptoclinum speciosum*.

The testis is large, and lies alongside the intestinal loop. The vas deferens is conspicuous; it commences by coiling from eight to ten times spirally around the testis (Pl. XXXIV. fig. 9).

Two small cylindrical colonies of this species were obtained at Station 142 near the Cape of Good Hope, from a depth of 150 fathoms. They are exactly like the elongated forms of *Leptoclinum speciosum*, var. *asperum* from Bahia (figured in Pl. XXXVI. fig. 9), in all respects except that the surface is perfectly smooth. The Ascidiozooids seem, however, to be rather more numerous and more closely placed than in *Leptoclinum speciosum*. The spicules vary a good deal in size, but resemble those of that species and its variety. These specimens from Station 142 seem to be in an intermediate condition between *Leptoclinum speciosum* and the variety *asperum*, and show therefore that the two forms cannot be regarded as distinct species.

[1] In this respect they resemble the spicules of some Alcyonaria, such as *Sarcodictyon* and *Alcyonium*. The simple spicules, formed of 1, 2, 3, or 4 pieces only, found in *Sarcodictyon* (see Herdman, On the Structure of Sarcodictyon, *Proc. Roy. Phys. Soc. Edin.*, vol. viii. p. 31, 1884) never seem to occur in the Leptoclinids.

Leptoclinum annectens, n. sp. (Pl. XXXIV. fig. 14, and Pl. XXXVIII. figs. 5–9).

The Colony is an irregularly rounded but thin and incrusting mass, which is attached by the greater part of the lower surface. The upper surface is uneven but fairly smooth. The colour is white.

The length is 3·5 cm., the breadth is 2 cm., and the thickness is 2 mm.

The Ascidiozooids are numerous and rather large. They are conspicuous on the outside of the colony. They are distributed evenly over the surface, and do not form definite systems. The branchial apertures are very distinct. A few common cloacal apertures are present. The bodies of the Ascidiozooids are distinctly divided into thorax and abdomen.

The Test is not very hard, and it is not stiff. It is opaque white throughout. The test cells are small and inconspicuous, and stellate calcareous spicules are abundant, especially near the upper surface. There are no bladder cells.

The Mantle is thin, and the musculature is feebly developed. The branchial siphon is short, and the sphincter muscle is not strong.

The Branchial Sac is well developed. The stigmata are large and regularly arranged. There are four rows, with six or seven stigmata in each row. The transverse vessels are very narrow, but have delicate muscle bands.

The Endostyle is narrow. Its course is straight.

The Dorsal Lamina is represented by a series of languets.

The Tentacles are long and narrow. There are sixteen of them; they are of two sizes and are placed alternately.

The Alimentary Canal is rather small. The stomach is globular and of small size.

Locality.—Off Bahia, Brazil, September, 1873; shallow water.

One colony of this species was obtained in shallow water off Bahia, on the east coast of South America. In external appearance it is not unlike *Leptoclium speciosum*, but differs in being not quite so white and smooth, and in having the Ascidiozooids more numerous and more closely placed. It resembles *Leptoclinum tenue* in some respects, but is much thicker and more solid and has the Ascidiozooids relatively smaller, while the spicules are, as a rule, larger.

The edges of the colony were not attached, but form free rounded projections. The Ascidizooids, which are very distinctly seen on the rest of the colony (Pl. XXXIV. fig. 14), do not extend quite up to the margin. Under a slight magnification with a lens the branchial apertures, which are just visible to the eye, can be seen clearly (Pl. XXXVIII. fig. 5, *br.*). They are each surrounded by six triangular lobes which give the aperture a stellate appearance when not widely open (Pl. XXXVIII. fig. 6). The common cloacal apertures are small. They are also stellate, but are not so distinctly six-lobed as the branchial apertures (Pl. XXXVIII. fig. 5, *cl.*).

The spicules in the test are much more numerous in the upper layer than in the deeper parts, and they are most abundant between the anterior ends of the bodies of the Ascidiozooids. Consequently in surface view under a low power the Ascidiozooids show through as closely placed elliptical areas of a lighter colour separated by bands of opaque test densely crowded with spicules. The edges of the lobes around the branchial apertures are strengthened with a line of spicules, and there is generally a little group which forms a thickening at the apex of each lobe.

The branchial sac is wide, but not long. The stigmata are particularly large and well developed (Pl. XXXVIII. fig. 8, *sg.*). The transverse vessels vary somewhat in calibre, but they are never very large. In some places they are exceedingly narrow, and the pointed ends of the stigmata in adjacent rows almost meet (Pl. XXXVIII. fig. 8, *tr.*). The ciliated cells are rather small; their free ends do not project.

The endostyle, though conspicuous, is not so wide as usual (Pl. XXXVIII. fig. 9, *en.*), and has not the undulating course so common in Compound Ascidians. The dorsal languets are narrow. The tentacles are very delicate, but the larger ones are rather long (Pl. XXXVIII. fig. 9, *tn.*). There are usually eight long and eight short. The nerve ganglion is ellipsoidal in form. The aperture of the dorsal tubercle is circular (Pl. XXXVIII. fig. 7, *d.t.*). It opens just posterior to the peripharyngeal band, and leads at once into a short wide infundibulum.

The œsophagus runs posteriorly from the branchial sac to open into the globular smooth-walled stomach. The intestine is long and forms a widish loop. It presents a small dilatation on its course just at its most posterior part.

Leptoclinum tenue, n. sp. (Pl. XXXIX. figs. 8–11, and Pl. XL. figs. 3–5).

The Colony is a small, more or less rounded, incrusting patch. It is thin, and is attached by the entire extent. The upper surface is fairly smooth. The colour is pure white.

The length is about 1·5 cm. and the breadth about 1 cm.; the thickness is very slight, 0·25 to 0·75 mm.

The Ascidiozooids are large and fairly numerous. They are closely and regularly placed all over the surface of the colony. Common cloacal apertures are not visible. The bodies of the Ascidiozooids are very short.

The Test is moderately firm, but tears easily. It is of an opaque white colour throughout. The structureless matrix contains minute rounded test cells and numerous calcareous spicules. There are no bladder cells. The spicules are mostly stellate and regular, but a few are nearly spherical or of irregular form.

The Mantle is rather muscular.

The Branchial Sac is small.

The Tentacles are few and short.

Locality.—(*a*) Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; depth, 175 fathoms; bottom, blue mud. (*b*) Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46° F. (*c*) Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2 F. (*d*) Station 12 of "Lightning" expedition in 1868; lat. 59° 36′ N., long. 7° 20′ W.; depth, 530 fathoms; bottom, "Atlantic ooze"; bottom temperaure, 6°·4 C. (=43°·5 F.).

Under this species I have united a number of specimens which resemble one another more or less closely.

About two dozen small specimens were obtained at Station 308, off the west coast of Patagonia, from a depth of 175 fathoms. The dimensions given in the above description are taken from one of the largest colonies, the smaller ones are only a couple of millimetres across. About twenty specimens were obtained at Station 311, at the western end of the Strait of Magellan, from a depth of 245 fathoms. Most of these are also small, but one or two extend to a larger size (2 to 2·5 cm. in length) than that of the specimens from Station 308. One large colony was obtained at Station 320, off the east coast of Patagonia, from a depth of 600 fathoms. In some respects this specimen differs from the others, and it may possibly be a distinct variety. A few small colonies obtained on September 6, 1868, during the cruise of the "Lightning," at Station 12, in the "warm area" of the Færoe Channel, from a depth of 530 fathoms, so closely resemble the South American forms that they are practically indistinguishable. Closely related to these specimens which are placed in the species proper there is another which I have regarded as forming a distinct variety (var. *magnizooidium*, see below).

In the typical specimens of *Leptoclinum tenue* the colony is small and rounded, and forms a thin incrusting layer, generally with a rather uneven upper surface (Pl. XXXIX. fig. 8). As a rule no common cloacal apertures are visible in the preserved specimens, but in one or two colonies a single centrally placed elliptical slit was present.

The Ascidiozooids are large and conspicuous. Their anterior ends form rounded projections on the upper surface, generally of an elliptical or nearly circular shape (Pl. XXXIX. fig. 9), and measuring about 0·5 mm. in the longer diameter. The Ascidiozooids are inclined at an angle to the surface of the colony, and are short antero-posteriorly. They are not arranged in definite systems (Pl. XXXIX. fig. 9).

The test, although opaque, is thin and rather soft. Its upper layer tears off readily, leaving the Ascidiozooids adhering to the lower part of the colony. A surface view of this upper layer of test, under a low power (Pl. XXXIX. fig. 10), shows the arrangement of the spicules very clearly. They are most numerous in the test immediately around the bodies of the Ascidiozooids, where they form dark circumscribing lines; inside these

areas, which are of circular or elliptical form (Pl. XXXIX. fig. 10), the spicules are scarce, and are scattered irregularly, while outside, in the test lying between the Ascidiozooids, they are fairly abundant. The six well-marked lobes which surround the branchial apertures are strengthened and rendered conspicuous by lines of spicules which border their edges (Pl. XXXIX. fig. 10, *br.*). In the deeper layers of the test the spicules are abundant. They are scattered irregularly.

The spicules are not large, and are fairly uniform in size. They are not so large as and are less densely packed than in the case of *Leptoclinum annectens*, which the present species resembles somewhat in general appearance. The majority of the spicules are regularly stellate in form, and have rather short rays. Here and there a few mammillated spherical forms occur, and occasionally deformed or monstrous forms with long irregular rays (Pl. XXXIX. fig. 11) are found; these abnormal spicules are, however, very rare.

The branchial siphon is large. It is lined by a layer of test containing spicules. The sphincter is well developed. The branchial sac is small, and is usually crumpled, doubtless from contraction in death. The stigmata are long and narrow, and the ciliated cells are distinct.

The endostyle is wide and its course is undulating. The tentacles are short. There are eight or ten of them.

The alimentary canal is small. The stomach is globular and smooth-walled. The intestine forms a short wide loop. The testis is large, and has the vas deferens coiled spirally around it.

A few large tailed larvæ were found in the colony. They have the body nearly circular in outline, with two pigmented sense organs placed on one side, nearer the anterior than the posterior end.

There are some undescribed specimens of *Leptoclinum* in the British Museum collection which were obtained during the cruise of the "Alert," from (*a*) Tom Bay, on the south-west coast of Chili, depth 0 to 30 fathoms; and (*b*) Sandy Point, in the Strait of Magellan, which are closely allied to the present species. They differ, however, in having the spicules more numerous and of a more spherical shape, the rays being generally very short and blunt.

The "Lightning" specimens obtained in the North Atlantic, between Scotland and the Færoe Islands, are all attached to a fragment of Coral (Pl. XL. fig. 3). They are of small size and of a pure white colour, and agree well in almost all points of structure with the Challenger specimens described above. The spicules, however, seem to be more closely placed in the superficial layer of the test, and especially over the areas occupied by the Ascidiozooids. Most of the spicules are of the same size and shape as those in the other specimens of the species (Pl. XL. fig. 4), but a few very much larger forms of regularly stellate shape, and provided with many rays (Pl. XL. fig. 5), occur scattered through the test.

Leptoclinum tenue, var. *magnizooidium*, nov. (Pl. XL. figs. 1, 2).

The Colony is a flat expansion of irregular shape. It is attached by its entire extent. The upper surface is even and smooth. The colour is a dull white.

The length is about 3 cm. and the breadth about 2 cm.; the thickness is from 1 to 2 mm.

The Ascidiozooids are very large and fairly numerous. They are placed regularly over the surface, but are not arranged in definite systems. No common cloacal apertures are visible. The Ascidiozooids have short bodies, and are placed obliquely in the colony.

The Test is soft and tears easily. It is of an opaque white colour throughout. The matrix contains a comparatively small number of minute test cells and a very large number of calcareous spicules. No bladder cells are present. The spicules are large, and are of very regular stellate form.

Locality.—Unknown.

The specimen for which I institute this variety was obtained during one of the cruises of H.M.S. "Porcupine," but the exact locality is unknown. It is attached to an old worn fragment of Coral (Pl. XL. fig. 1).

The colony is of irregular form, and has a thin expanded margin. Like the specimens of *Leptoclinum tenue*, it has large distinct Ascidiozooids which make conspicuous marks on the upper surface, but it differs from them in having the edges less definite and rounded, in not being so white in colour, and in having both the Ascidiozooids and the spicules distinctly larger. The upper surface of the colony also is rather smoother in the present variety (Pl. XL. fig. 1).

The arrangement of the spicules in the upper layer of the test is essentially the same, but they are more numerous in the variety than in the typical members of the species, The areas between the Ascidiozooids are quite opaque, and over the bodies of the Ascidiozooids the spicules are fairly numerous. The edges of the six lobes round the branchial aperture are strengthened by masses of closely placed spicules.

The spicules in the variety are all of the same size, and are remarkably regular in form. They are stellate (Pl. XL. fig. 2). The rays are not very long, and are moderately sharp. No irregular or deformed spicules were noticed.

Leptoclinum propinquum, n. sp. (Pl. XXXIX. figs. 16–20).

The Colony is of irregularly rounded form, and is closely attached by its entire extent. The upper surface is smooth. The colour is a greyish-white.

The length is about 2 cm. and the breadth 1 cm., the thickness is 1 mm.

The Ascidiozooids are fairly large and numerous. They are very conspicuous externally, but are not arranged in definite systems. No common cloacal apertures are present. The bodies of the Ascidiozooids are short, and are divided into thorax and abdomen.

The Test is rather soft, and tears easily. It is of a greyish-white colour, and is nearly opaque. The matrix contains small test cells and numerous calcareous spicules. There are no bladder cells. The spicules vary somewhat in size. They are of rather regular stellate forms.

The Mantle is fairly muscular. The branchial sphincter is well developed.

The Branchial Sac is small. It has three rows of small but regularly arranged stigmata.

The Alimentary Canal is rather large. The stomach is globular and smooth-walled.

Locality.—Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46° F.

Several small colonies of this species are attached to a worn fragment of Coral trawled at Station 311, at the western end of the Strait of Magellan, from a depth of 245 fathoms. The dimensions given above are those of the largest colony, the others are considerably smaller. They are all incrusting forms (Pl. XXXIX. fig. 16), and resemble the specimens of *Leptoclinum tenue* closely in their external characters. The colour, however, is distinctly greyer, and the Ascidiozooids are rather larger, and are placed further apart in the present species. The arrangement of the spicules in the surface layer of test is quite different in the two cases (compare figs. 10 and 17 in Plate XXXIX.). In the present species they are uniformly distributed, except immediately around the branchial apertures, where they are more numerous. The edges of the six lobes are especially strengthened by closely placed spicules. The branchial apertures are regularly six-rayed (Pl. XXXIX. fig. 17, *br.*).

The spicules are mostly stellate, with many narrow pointed rays (Pl. XXXIX. fig. 20). Some, however, have the rays shorter and broader so as to produce a more nearly spherical form of spicule. The test cells are very inconspicuous. Most of them are small and rounded, but a few elongated and some larger branched forms occur.

The thorax and abdomen in the body of the Ascidiozooids are distinctly separated (Pl. XXXIX. fig. 18), and are of about the same size. There are two strong retractor muscles, one running backwards on each side from the branchial sphincter, along the dorsal edge of the thorax.

The transverse vessels of the branchial sac are narrow (Pl. XXXIX. fig. 19, *tr.*); they are usually of the same size as the fine longitudinal vessels. The ciliated cells bounding the stigmata are distinct (Pl. XXXIX. fig. 19, *sg.c.*). The endostyle is very large and conspicuous (Pl. XXXIX. fig. 18); its course is straight.

The alimentary canal forms a wide loop. The œsophagus leaves the dorsal edge of the posterior end of the branchial sac, and runs directly backwards to the large smooth-

walled stomach (Pl. XXXIX. fig. 18). The intestine leaves the posterior end of the stomach and at once turns dorsally and then anteriorly. It lies close to the œsophagus at the posterior end of the branchial sac.

The testis forms a large rounded mass placed alongside the intestine (see Pl. XXXIX. fig. 18). The vas deferens commences by coiling spirally around the testis. No ova and no embryos were discovered in the colony.

This form is one of those which make me very doubtful as to the propriety of separating the genera *Didemnum* and *Leptoclinum* by the number of rows of stigmata in the branchial sac. If that course were adopted, the present form would have to be regarded as a species of *Didemnum*, but the extreme thinness of the colony (about 1 mm.) is a strong argument against such a view. Then, again, it is so similar in some respects to the specimens of *Leptoclinum tenue* from the west coast of South America and from the North Atlantic, that for some time I hesitated to describe *Leptoclinum propinquum* as a distinct species, and cannot therefore bring myself to regard these two forms as belonging to separate genera.

Leptoclinum neglectum, n. sp. (Pl. XXXVIII. figs. 10–13).

The Colony is irregularly shaped, and incrusting. It is attached by the greater part of its lower surface. The upper surface is fairly smooth. The colour is a dull white.

The length is about 3 cm., the breadth 1·5 cm., and the thickness 2 mm.

The Ascidiozooids are numerous but rather small. They are distributed evenly over the surface of the colony, and are not arranged in definite systems. A few slit-like common cloacal apertures are visible.

The Test is moderately hard and firm. It is of a greyish-white colour in most parts, and is quite opaque. The matrix contains small rounded test cells and large numbers of calcareous spicules. No bladder cells are present. The spicules are large and of regular stellate form.

The Mantle is moderately strong, both transverse and longitudinal muscles are present.

The Branchial Sac is short and wide. The stigmata are large and regularly arranged. The ciliated cells are distinct.

The Tentacles are few and of small size.

The Alimentary Canal forms a long narrow loop.

Locality.—Unknown.

This colony, which was found in a small bottle without a label, and of which therefore the locality is unknown, is in some respects allied to *Leptoclinum annectens*, and in others resembles *Leptoclinum tenue*, but is, I consider, sufficiently distinct from both to be entitled to a separate description.

It adheres to a fragment of Sponge, round one branch of which it has grown so as to completely incrust it (Pl. XXXVIII. fig. 10). The edges are free rounded projections containing no Ascidiozooids. Over the rest of the surface the Ascidiozooids are closely placed. They are conspicuous externally and form small circular grey dots about 0·25 mm. to 0·30 mm. in diameter. The common cloacal apertures are 1 mm. to 1·5 mm. in length.

The spicules in the test are very abundant. They vary a little in size, but are very regular in form (Pl. XXXVIII. fig. 13); no spherical spicules were noticed. In the surface layer of test the spicules are less crowded over the bodies of the Ascidiozooids than between them (Pl. XXXVIII. fig. 11), consequently the appearance of a strong network with circular spaces is produced just as in the case of *Leptoclinum tenue* and some other species, but in the present case the areas occupied by the Ascidiozooids are relatively much smaller, and the dark masses of test between are larger (Pl. XXXVIII. fig. 11). The edges of the six lobes surrounding the branchial apertures are strengthened by lines of closely placed spicules (Pl. XXXVIII. fig. 12); the base of the lobe has generally few or no spicules.

The branchial sphincter is very large (Pl. XXXVIII. fig. 12, *sph.*), but otherwise the muscular system is not strong.

The branchial sac has long stigmata with pointed ends. They are regularly arranged, and their ciliated ends are large, and have pointed free ends. The endostyle is large and conspicuous. Its course is slightly undulating.

The nerve-ganglion is an ellipsoidal mass, placed close to the peripharyngeal band.

The stomach is small. The intestine is long and narrow, and the intestinal loop is very slight, the rectum being placed close to the intestine and stomach. The rectum contains dark-coloured fæcal pellets. The testis is large and has a spirally coiled vas deferens. No ova and no embryos were discovered in the colony.

Leptoclinum albidum, Verrill (?).

Leptoclinum albidum, Verrill, Brief Contributions to Zoology, &c., Amer. Journ. Sci. and Arts, ser. 3, vol. i. No. 6, p. 443, June 1871.

The Colony is a thin expanded layer of irregular shape. It is incrusting, and is attached by its entire extent. The upper surface is uneven but moderately smooth. The colour is a dull greyish-white.

The length is about 5 cm., the breadth about 3 cm., and the thickness about 1 mm.

The Ascidiozooids are very numerous and of rather small size. They are usually distributed evenly over the upper surface of the colony. Common cloacal apertures are usually visible. The Ascidiozooids are placed nearly vertically in the colony, and their bodies are divided into two regions—thorax and abdomen.

The Test is not very hard; it is flexible, but tears easily. It is of a dirty white colour, and is opaque. The matrix contains the usual small test cells, and also large numbers of stellate calcareous spicules, which are most closely placed in the regions between the anterior ends of the Ascidiozooids. In the deeper parts of the test they are not so abundant as in the superficial layer.

The Mantle is moderately strong and muscular.

The Branchial Sac is large and well developed. The stigmata are long, and are arranged with regularity.

The Endostyle is conspicuous.

The Dorsal Lamina is represented by a series of long languets.

Localities.—(*a*) Off San Iago, Cape Verde Islands; depth, 100 to 125 fathoms (one colony). (*b*) Off San Iago, Cape Verde Islands; depth, 10 to 20 fathoms (one colony). (*c*) Simon's Bay, Cape of Good Hope; depth, 10 to 20 fathoms (several colonies).

There are a number of specimens of *Leptoclinum* in the Challenger and "Porcupine" collections which are either very closely allied to or identical with Verrill's *Leptoclinum albidum*. In 1871[1] Professor Verrill described briefly, without figures, the species *Leptoclinum albidum* and its variety *luteolum*.[2] I have been enabled to examine several specimens of both these forms from the collections sent out to museums by the United States Commission of Fish and Fisheries, and the new specific description which I have considered it necessary to give above is derived partly from these American specimens and partly from those in the Challenger collection.

A specimen obtained during the Challenger Expedition, off San Iago, Cape Verde Islands, from a depth of 100 to 125 fathoms, agrees closely with preserved specimens both of *Leptoclinum albidum* and of *Leptoclinum albidum*, var. *luteolum*. It measures about 3·5 cm. in length and 2 cm. in breadth, and is very thin, scarcely 1 mm. in the thickest part, and in many places much less. It occurs incrusting a lump of Sponge, over which it has spread irregularly. There is also a very small colony of probably the same species attached to the Sponge.

The Ascidiozooids are moderately large and rather conspicuous. They are placed slightly further apart than is usual in *Leptoclinum albidum*. They are of a greyer colour than the surrounding test. No common cloacal apertures are visible.

The test is opaque between the Ascidiozooids, and translucent over them, where there are fewer spicules present. The clearer areas thus formed on the surface of the colony are generally elliptical in shape and are about 0·4 mm. in the longer diameter.

[1] *Amer. Journ. Sci. and Arts*, ser. 3, vol. i. No. 6, p. 443.

[2] Named as a distinct species in the paper quoted.

The spicules are abundant, especially in the upper layers of the test between the Ascidiozooids. They are usually stellate, with tapering rays and sharp points, but here and there deformed and irregular forms occur. They are most of them slightly larger than those of the named specimen of *Leptoclinum albidum* in which I examined the spicules, but are exactly like those of the named *Leptoclinum albidum*, var. *luteolum*.

A small colony of roughly circular form and about 2 cm. across, which was obtained off San Iago, Cape Verde Islands, from a depth of 10 to 20 fathoms, seems also to belong to *Leptoclinum albidum*, Verrill. It is attached to some object in the form of a dome about 1·5 cm. high, which it closely incrusts. The colony is slightly thicker, and the test seems a little whiter and more opaque than in the case of the specimen from deeper water in the same neighbourhood, but in other respects the structure is the same.

One large colony and a few smaller ones and some fragments which were obtained in Simon's Bay, Cape of Good Hope, from a depth of 10 to 20 fathoms, differ very slightly from those above described. They are of very irregular shape, and are thicker (from 1 to 3 mm.) than the specimens from Cape Verde Islands. They are also more opaque and not so grey in colour. The markings on the upper surface caused by the anterior ends of the Ascidiozooids are in some places rather smaller and more irregular, but in other parts of the colony they are of the normal size.

The spicules both in shape and arrangement differ somewhat from those of both the North American and the Cape Verde Island specimens; they are rather larger, and are decidedly more irregular both in shape and distribution. Some of them are of a regular stellate form, but spherical, mammillated, and quite irregular spicules are of common occurrence throughout the test. Some of the larger irregular spicules are composed of several fan-shaped pieces joined together to form an incomplete disk which is marked by concentric and radial lines exactly like those on the discoid spicules of *Cystodytes*. This peculiar form of spicule occurs also in *Leptoclinum subflavum* (see p. 294, and Pl. XXXVIII. fig. 16).

In the specimens from Simon's Bay, as in those from the Cape Verde Islands, the Ascidiozooids are distributed more or less evenly over the surface, and show no arrangement into systems or lines; but in those colonies allied to *Leptoclinum albidum* which still remain to be considered, the anterior ends of the Ascidiozooids form on the upper surface a well marked reticulum composed of branching and anastomosing lines. This arrangement seems also to be generally found in Verrill's *Leptoclinum albidum*, var. *luteolum*, though not so markedly in the species itself. As all the specimens I have examined have been preserved in alcohol, unfortunately colour cannot be made use of as a distinguishing character.

Leptoclinum albidum, var. *luteolum*, Verrill (?) (Pl. XL. figs. 10–15).

Leptoclinum luteolum, Verrill, Brief Contributions to Zoology, &c., Amer. Journ. Sci. and Arts, ser. 3, vol. i. No. 6, p. 443, June 1871.

Half a dozen colonies obtained during the cruise of the "Porcupine" in Tangier Bay, on the coast of Morocco, on August 5, 1870, from a depth of 35 fathoms, resemble closely the named specimens of Verrill's *Leptoclinum albidum*, var. *luteolum*. What the colour was when living is unknown; after fifteen years' preservation in alcohol it is a dull greyish-white, with darker lines running along the rows of Ascidiozooids.

The shape of the colonies is irregular (Pl. XL. figs. 10, 11). They are incrusting, and are attached by the greater part of the lower surface. The edges are rounded and projecting; they contain no Ascidiozooids. The thickness is considerable. It may extend up to 4 mm. In such a case the Ascidiozooids occupy only the upper 2 mm. or so of the colony, and the lower half is solid test.

The Ascidiozooids are fairly numerous, but small. They are placed vertically in the test, and their anterior ends are visible as minute rounded dots on the surface. They are so arranged that their anterior ends form lines which branch and unite at fairly equal distances so as to form a close network over the surface (Pl. XL. fig. 10). Each line is really formed of two rows of Ascidiozooids closely placed and running parallel. Between the rows is found a canal-like extension of one of the common cloacal cavities, while the meshes of the network are formed by areas of test towards which the ventral surfaces of the surrounding Ascidiozooids are turned. This arrangement in linear and branched systems is exactly the same as that found in many species of the genus *Botrylloides* (see p. 40, and Pl. I. fig. 4). In museum specimens of *Leptoclinum albidum*, var. *luteolum*, Verrill, from North America, the same arrangement of the Ascidiozooids is seen, but it is usually not so well marked as in the colonies from Tangier Bay, figured on Plate XL.

The common cloacal apertures are numerous and conspicuous (Pl. XL. figs. 10, 11). They are ovate or elliptical slits, generally about 2 mm. in length and 1 mm. across at the widest point. The surface of the colony is uneven and rather rough.

The test is of considerable thickness, and is hard and firm. The matrix is closely crowded with test cells and spicules. A few bladder cells are also present in some parts. The test cells are rather large. They are of rounded and ovate forms and are granular. The spicules are stellate and fairly regular (Pl. XL. fig. 12).

The mantle is moderately muscular, the branchial sphincter is well developed, and there are strong retractor muscle bands running along the dorsal edge of the thorax.

The branchial sac is long and narrow. The stigmata are large and are arranged in three rows separated by wide transverse vessels. The endostyle is very large and conspicuous. The dorsal languets are long and narrow.

Both ova and a testis were found in the abdomen of the Ascidiozooids. The vas deferens is coiled spirally around the testis. Several very large tailed larvæ (Pl. XL. fig. 13) were also found in the colony. In these the young test is very distinctly broken up into a network by numerous polygonal bladder cells (see Pl. XL. figs. 13, 14). The tail and its urochord are both very distinct, although the larva figured is evidently in an advanced stage of development; the three rows of stigmata in the branchial sac are already formed. Two pigmented sense organs are present, and the larva is provided at its anterior end with three well-developed adhering organs (Pl. XL. figs. 13, 15; the latter figure shows the termination of one of the adhering organs on the surface of the test, highly magnified).

I have given these details in regard to the specimens from Tangier Bay, as they may possibly turn out to be distinct from Verrill's variety, although they are certainly closely allied to it. To decide the matter both forms would require to be examined in the living condition.

Leptoclinum albidum, var. *grande*, nov. (Pl. XXXV. figs. 11–14).

The Colony is a large incrusting mass prolonged at its edges into considerable lobes and ridges with rounded ends. It is attached by the entire lower surface. The upper surface is uneven and is slightly rough all over. The colour is opaque whitish-grey.

The length is 8·5 cm., the greatest breadth is 6·5 cm., and the thickness varies from 1 mm. to nearly 1 cm.

The Ascidiozooids are very numerous but small. They are arranged so as to form a close reticulum over the whole surface. A few common cloacal apertures are visible. The Ascidiozooids are placed vertically in the test. In the thickened portions they only occupy the outer layer of the colony. Their branchial apertures occupy slight rounded projections on the surface.

The Test is hard and firm. It is relatively of large amount. It is of a dull greyish-white colour, and is quite opaque throughout. The matrix is densely crowded with calcareous spicules in all parts except in the immediate neighbourhood of the branchial apertures. Test cells are also abundant in the matrix; they are of very small size, and are mostly rounded in form. No bladder cells are present. The spicules are large and are of regular stellate shape. The rays are long and have sharp points.

The Mantle is rather thick and muscular. The branchial sphincter is well developed, and there are retractor muscles on each side of the body.

The Branchial Sac is small. The stigmata are short, but regularly arranged.

The Endostyle is narrow. Its course is straight.

The Alimentary Canal is of small size.

Locality.—Station 209, January 22, 1875; lat. 10° 14′ N., long. 123° 54′ E.; depth, 95 fathoms; bottom, blue mud; bottom temperature, 71° F.

One large colony and several fragments of this well-marked variety were obtained from a depth of 95 fathoms at Station 209, off Zebu, in the Philippine Islands. It is closely allied to *Leptoclinum albidum*, Verrill, and in the arrangement of the Ascidiozooids it resembles Verrill's variety *luteolum*, but it has certainly sufficient peculiarities of its own to warrant its being considered as a distinct variety, if not a separate species.

The large colony is a magnificent specimen (see Pl. XXXV. fig. 11). It is the largest of the Didemnidæ in the collection. It is an incrusting mass which is attached to a large Lamellibranch, over which it has grown so as to completely bury both sides of the shell with the exception of a small area at one end of the hinge-line. At the opposite end of the colony, corresponding to the ventral edge of the shell, there is a narrow line across which the Ascidian is not continuous from side to side. Union has evidently been prevented from taking place in this region by the opening and closing of the mouth of the shell, so as to form a passage by which water might reach the Lamellibranch inside. The upper end of the colony and some parts of the surface are prolonged into rounded ridges and finger-like lobes with blunt ends (Pl. XXXV. fig. 11). The average thickness of the colony is probably about 3 or 4 mm., but in some places it is three times as much.

At the base (the dorsal edge of the shell) for a short distance there is a thin expanded edge formed in which no Ascidiozooids are present, and the test is very thin. Over the rest of the colony on both sides the Ascidiozooids are exceedingly numerous. They are arranged very much as in *Leptoclinum albidum*, var. *luteolum*, so as to form a close network of lines over the surface (Pl. XXXV. fig. 11). These lines are of a greyer colour than that of the test in the meshes, and they are occupied by canal-like extensions from the common cloacal cavities. The Ascidiozooids border the lines, but are also placed here and there in the meshes, which are not so large as in the specimens of *Leptoclinum albidum*, var. *luteolum* from Tangier Bay (p. 290, Pl. XL. figs. 10, 11). Consequently, although a general view of the colony gives the impression that the Ascidiozooids occupy merely the edges of the branching lines (Pl. XXXV. fig. 11), a closer examination shows that in most places they are really scattered closely all over the surface (Pl. XXXV. fig. 12), and that the grey lines formed by the cloacal canals wind in and out between them.

The Ascidiozooids are small, and do not extend far into the test. Both thorax and abdomen are short. The branchial apertures project slightly above the general surface and cause a rough appearance. A surface view of the colony under a low power of the microscope shows (Pl. XXXV. fig. 12) the numerous open branchial apertures of the Ascidiozooids surrounded each by two circles, the outer of which is the

place where the spicules in the surface layer of the test over the Ascidiozooid become greatly reduced or altogether cease, while the inner is the branchial sphincter.

The distribution of the spicules in the surface layer of test is also distinctly seen in a low power view of the colony (Pl. XXXV. fig. 12). They are most abundant between the bodies of the Ascidiozooids, where the dark opaque lines form a network with fairly regular hexagonal meshes. The regions occupied by the Ascidiozooids are thus clearly marked out (Pl. XXXV. fig. 12). A higher magnification shows that the branchial aperture is irregularly six-lobed (Pl. XXXV. fig. 13, *br.*). The bases of the lobes are usually strengthened by a few spicules, which are arranged in two, three, or four groups (generally three); these are shown as small dark masses on the line of the sphincter muscle in figure 12.

The spicules have the rays more tapering and the apices sharper (Pl. XXXV. fig. 14) than is usual amongst allied forms. The mantle has both transverse and longitudinal muscle bands (Pl. XXXV. fig. 13).

The branchial sac has small but well-formed stigmata; the ciliated cells are distinct. The testis is large, and the vas deferens is spirally coiled around it. No ova nor embryos were discovered in the colony.

Leptoclinum subflavum, n. sp. (Pl. XXXVIII. figs. 14–18).

The Colony is a thin incrusting layer of irregular shape, attached by its entire extent. The upper surface is even, but rather rough. The colour is yellow.

The length is about 2·5 cm., the breadth about 2 cm., and the thickness is less than 1 mm.

The Ascidiozooids are moderately large, and fairly numerous. They are closely placed all over the surface, and are not arranged in definite systems. No common cloacal apertures are visible.

The Test is rather firm. It is of a greyish-yellow colour and is transparent. The matrix is crowded with test cells which are mostly of large size and rounded form. Calcareous spicules are also present, but they are most irregular in size and shape. They are never stellate.

The Mantle is moderately strong. The muscle bands are delicate but numerous. They are mostly longitudinal in direction, and are placed regularly.

The Branchial Sac is rather small and is thick-walled. The stigmata are usually small, but are arranged with regularity. There are four rows. The ciliated cells are distinct.

The Dorsal Lamina is represented by a series of rather short tentacular languets.

The Tentacles are short and stout. There are from twelve to sixteen of them.

The Alimentary Canal is moderately large. It forms a short loop.

Locality.—Kerguelen Island; depth, 28 fathoms.

This is a small incrusting species, a specimen of which was found attached to the test of a large Simple Ascidian from Kerguelen Island. It is quite flat (Pl. XXXVIII. fig. 14), and the edges are expanded. The colour is a warm yellowish-grey.

The Ascidiozooids are conspicuous (Pl. XXXVIII. fig. 14). They form slight rounded elevations all over the surface, and are closely placed. Their bodies are nearly 1 mm. in greatest breadth. They are divided into two regions, thorax and abdomen (Pl. XXXVIII. fig. 15).

The test cells are mostly of very large size. In some places smaller ones occur aggregated together in spherical or ellipsoidal clumps. All these cells stain deeply with carmine, and so give the test a minutely dotted appearance under a low power. A few vascular appendages are found in the test; they are narrow and straight, and have long ovate swellings at their ends.

The spicules are fairly abundant. They are more numerous near the upper and lower surfaces than in the deeper parts of the test, and are of most irregular form (Pl. XXXVIII. fig. 16). The smaller ones are usually more or less rounded. The larger ones, which attain to 0·3 mm. in length, are discoid or ellipsoidal or lobed. No regular spherical or stellate spicules were discovered. Many of the larger spicules are marked by radiating and concentric lines (Pl. XXXVIII. fig. 16) like those seen still more distinctly in the large discoid spicules of *Cystodytes*.

The mantle is rather opaque, and is fairly muscular. The branchial siphon is large (Pl. XXXVIII. fig. 15), and the sphincter is well developed. In addition to the delicate longitudinal and transverse muscle bands, which are closely placed all round the body, there are two strong bands which run longitudinally down the dorsal edge of the thorax. They are separated by a narrow clear space which is the median dorsal line, and from which the dorsal languets project inwards.

The branchial sac is rather strong, the stigmata being narrow and the vessels rather wide (Pl. XXXVIII. figs. 15, 17). The transverse vessels are provided with bundles of muscle fibres (Pl. XXXVIII. fig. 17, *m.f.*). The stigmata vary greatly in length. In some cases they are much longer than those represented in the figure (Pl. XXXVIII. fig. 17, *sg.*).

The tentacles are irregular. None of them are long, but some are larger than others (Pl. XXXVIII. fig. 18). They are not arranged according to size, and they vary also in number in the different Ascidiozooids.

The alimentary canal forms a rounded mass placed close behind the branchial sac (Pl. XXXVIII. fig. 15), so that the body, as a whole, is short and compact. The stomach is not large; it is smooth-walled. The intestine is short but wide.

The reproductive organs were not well developed in any of the Ascidiozooids examined. The vas deferens coils spirally around the testis.

Leptoclinum jeffreysi,[1] n. sp. (Pl. XL. figs. 6–9).

The Colony is a flattened expansion of irregular form. It is incrusting, and is attached by the whole of the lower surface. The upper surface is somewhat uneven but smooth. The colour is a dull creamy white.

The length is 3·5 cm., the breadth is about 2 cm., and the thickness is from 1 to 2 mm.

The Ascidiozooids are fairly numerous, but of small size. Their anterior ends are visible on the upper surface as small inconspicuous dots. They seem to be scattered evenly over the colony. No common cloacal apertures are visible.

The Test is hard and brittle. It is of a white colour and quite opaque. The upper surface contains great numbers of calcareous spicules, while the lower part is crowded with large bladder cells, and has no spicules. Small test cells are scattered all through the matrix, but they are not numerous. The spicules are stellate, but their rays are short and wide. They are of a slightly yellow colour.

The Mantle is thin and not strongly muscular. The branchial sphincter is strong.

The Branchial Sac is small and feebly developed.

The Endostyle is conspicuous.

Locality.—Tangier Bay, Morocco, August 5, 1870; depth, 35 fathoms.

One colony of this species was obtained during the Mediterranean cruise of the "Porcupine," in the summer of 1870, in Tangier Bay, from a depth of 35 fathoms. It is a small irregularly shaped expansion of a dirty cream colour, and having various fragments of Polyzoa and sand grains attached to its lower surface and edges (Pl. XL. fig. 6). The Ascidiozooids are small and inconspicuous. They occupy only the upper half or so of the thickness of the colony (Pl. XL. fig. 7), and they are not arranged in definite systems.

Vertical sections through the colony show that the test may be divided into two zones (see Pl. XL. fig. 7); an upper containing the bodies of the Ascidiozooids, and densely crowded with calcareous spicules, and a lower into which the Ascidiozooids do not extend, and which contains no spicules, but is occupied by a large number of bladder cells (Pl. XL. figs. 7, 8). The bladder cells are usually spherical, but in some places they become polygonal from mutual pressure. They do not extend quite to the lower surface of the colony (Pl. XL. fig. 8, *l.s.*).

The spicules are of moderate size and usually of stellate form, but the rays are very short and wide and the central part is large, so that the spicule as a whole has often the appearance of a sphere covered with small pointed excrescences. The spicule

[1] This species and the two following ones are named in honour of the three distinguished naturalists who conducted the scientific investigations during the cruises of H.M.SS. "Lightning" and "Porcupine" in the summers of 1868, 1869, and 1870—the late Dr. Gwyn Jeffreys, the late Dr. W. B. Carpenter, and the late Sir Wyville Thomson.

figured (Pl. XL. fig. 9) is one of the larger and more regularly stellate ones. Many of the others are much smaller and more spherical. The spicules have a slight yellow colour, which probably gives the creamy tint to the colony as a whole.

The testis is a large globular mass around which the vas deferens is coiled spirally. Part of the vas deferens is seen in the section figured (Pl. XL. fig. 7, at the right hand side of the figure).

Leptoclinum carpenteri, n. sp. (Pl. XLI. figs. 1–4).

The Colony forms an irregularly ovate or rounded mass, incrusting, but not flattened. Its surface is fairly even and quite smooth. The colour is a dull white.

The length is about 1·5 cm., the breadth about 1 cm., and the thickness about 0·5 cm.

The Ascidiozooids are inconspicuous and show no definite arrangement in systems. No common cloacal apertures are visible. The body of the Ascidiozooid is slightly elongated vertically, and is distinctly divided into two regions—thorax and abdomen.

The Test is soft and flexible. It is of a greyish-white colour, and is almost quite opaque. In sections the structureless matrix is seen to contain large numbers of very minute test cells, and a comparatively small number of calcareous spicules. The spicules are of regular stellate form, but vary considerably in size.

The Mantle is transparent, but is of moderate strength over the thorax. It has fine muscle bands running both longitudinally and transversely.

The Branchial Sac is short but wide. It has four rows of moderately long stigmata. The transverse vessels are rather wide, and are provided with muscle fibres.

The Alimentary Canal is long and narrow, it forms a wide loop. The stomach is short and rather quadrate in outline.

Locality.—Unknown.

Several specimens of this species were found during one of the cruises of the "Porcupine" attached to Algæ along with specimens of *Leptoclinum thomsoni* (see Pl. XLI. fig. 1, where B. represents the present species). The exact locality from which the specimens were obtained is not known.

The colonies are all more or less rounded masses of considerable thickness which have grown around the Algæ. They are readily distinguished from the similar specimens of *Leptoclinum thomsoni* by being much softer and more flexible, and by the colour, which in the present species is a dirty white with a slight greyish tint. The Ascidiozooids also are not nearly so distinct as in the case of *Leptoclinum thomsoni* (compare A. and B., Pl. XLI. fig. 1).

The surface of the colony is smooth and soft, and sections show (Pl. XLI. fig. 2) that the superficial layer is formed of test only and contains no spicules.

The Ascidiozooids, although of fair size, are in most places not visible on the exterior of the colony (Pl. XLI. fig. 1, B.), but in a few spots they can be made out as small white rounded areas. The body as a whole is elongated antero-posteriorly, and is placed at right angles to the surface (Pl. XLI. fig. 2). The abdomen is rather larger than the thorax.

The test is relatively large in amount, and is remarkably soft and flexible for a Leptoclinid. The test cells are very numerous, and are mostly of small size and of rounded or fusiform shapes; here and there, however, larger test cells of stellate and branched forms occur (Pl. XLI. fig. 3, *t.c.*).

The spicules are much less numerous than in most species of *Leptoclinum* (Pl. XLI. figs. 2, 3). Some of them are twice or even three times as large as others, but they are all stellate in form, and their rays are regular and pointed at the apices (Pl. XLI. fig. 3, *sp.*). A vertical section through the colony (see Pl. XLI. fig. 2), shows that the spicules are not equally scattered all through the test, but are most abundant immediately around the anterior ends of the Ascidiozooids. At this level the spicules form a continuous dense band stretching throughout the section, becoming thickened in the neighbourhood of each Ascidiozooid and thinning out in the intermediate regions. Above this band the superficial layer of test, as we have already seen, contains no spicules (Pl. XLI. fig. 2, *t.m.*); while below, in the deeper parts of the colony, spicules are present, but they are scattered sparsely and evenly through the test.

Retractor muscle bands and ectodermal processes from the Ascidiozooids are also met with in the test (Pl. XLI. figs. 2, 3, *m.b.*, *v.*). The latter are given off from the œsophageal region of the body where the thorax and the abdomen join, and they run mainly in a posterior direction, towards the centre of the colony. They are not very long and do not give off any branches. Their ends are rounded and slightly dilated (Pl. XLI. fig. 3, *v.*).

The branchial siphon is lined by test which contains spicules (Pl. XLI. fig. 2). The sphincter surrounding it is well marked. The endostyle is large and conspicuous. The branchial sac is remarkably wide dorso-ventrally, usually it is as wide as or wider than its antero-posterior length. The stigmata are well formed (Pl. XLI. fig. 4), and the muscle bands in the transverse vessels are unusually strong. In one of the Ascidiozooids shown in the section (Pl. XLI. fig. 2), only three rows of stigmata were visible in the branchial sac. The posterior end of the branchial sac is very wide and flat, and it is from this region, between the posterior extremity of the endostyle and the œsophageal opening, that the ectodermal processes or vessels arise (Pl. XLI. fig. 2).

The œsophagus commences at the dorsal edge of the posterior end of the branchial sac and runs straight backwards for a short distance to open into the short, and, in some cases, almost cubical stomach (see Pl. XLI. fig. 2). There is a certain amount of variability in the form of the stomach even in Ascidiozooids of the same colony. The

second Ascidiozooid represented in the figure shows an ovate stomach with the long axis antero-posterior, and the posterior end narrow. In transverse sections the lumen of the stomach is seen to be cruciform (Pl. XLI. fig. 2, *st.*). This is produced by the presence of four longitudinal pads of thickened epithelium. The intestine is long. It runs posteriorly from the stomach and then turns ventrally in rather a wide curve, and before turning anteriorly it becomes more or less distinctly thickened for a short distance (Pl. XLI. fig. 2, where the Ascidiozooid at the left side of the figure shows the thickening more than usually distinct, and forming a considerable enlargement on the intestine). From this point the rectum runs anteriorly and dorsally so as to reach the œsophagus which it crosses. The intestinal loop is wide.

The testis, in the form of a single large ovate mass (Pl. XLI. fig. 2, *t.v.*), was present in some of the Ascidiozooids examined, but no ova and no embryos were discovered in any part of the colony.

Leptoclinum thomsoni, n. sp. (Pl. XLI. figs. 1, 5–7).

The Colony is an irregular mass, incrusting and rather flat. The surface is moderately even and smooth. The colour is opaque white.

The length is about 2 cm., the breadth about 0·7 cm., and the thickness 2·5 mm.

The Ascidiozooids are numerous but small. They are distributed evenly over the surface of the colony, and are not arranged in regular systems. No common cloacal apertures are visible. The body of the Ascidiozooid is divided into two distinct regions, thorax and abdomen.

The Test is hard and firm. It is of a creamy white colour, and is quite opaque. In sections the clear structureless matrix is seen to contain a few delicate test cells and a large number of calcareous spicules. The spicules are fairly large, and are of very regular stellate form. In some places they are densely crowded.

The Mantle is rather muscular. It has both longitudinal and transverse bands.

The Branchial Sac is moderately large. It has three or four rows of large stigmata which are arranged with regularity. The transverse vessels are provided with muscle fibres.

The Endostyle is large and conspicuous. Its course is greatly convoluted.

The Dorsal Lamina is represented by a series of languets.

The Alimentary Canal is large. The stomach is fusiform and smooth-walled.

Locality.—Unknown.

Some colonies of this species were found attached to Algæ, along with specimens of *Leptoclinum carpenteri*, during one of the cruises of the "Porcupine." The exact locality is unknown.

The colonies are of irregular shape (see Pl. XLI. fig. 1, where A. represents the present species), and are not so rounded as those of *Leptoclinum carpenteri* (Pl. XLI. fig. 1, B.). They are also flatter and more spreading, of a slightly whiter colour, and much harder and firmer, and not so smooth to the touch, consequently there is no difficulty in distinguishing the two species even by their external characters only. The Ascidiozooids also are clearly visible in the present species, which is not the case in *Leptoclinum carpenteri* (see Pl. XLI. fig. 1, A. and B.). The branchial apertures lie in minute depressions which are closely placed all over the surface of the colony.

The colonies are of various sizes, from a few millimetres to 2 centimetres in length. They are all attached to parts of the Alga, around which they have grown so as to completely imbed it. The surface of the colony feels hard and slightly rough, but no projections are visible. Vertical sections show (see Pl. XLI. fig. 5) that as in the case of *Leptoclinum carpenteri* the superficial layer is formed of test containing no calcareous spicules.

The Ascidiozooids as a general rule are placed at right angles to the surface of the colony, but in some cases they are inclined at an angle to it. The abdomen is sometimes not directly posterior to the thorax, but is bent upwards so as to lie partially on its dorsal edge (Pl. XLI. fig. 5, right hand side).

The test is, relatively to the size of the colony, not so large in amount as in the case of *Leptoclinum carpenteri*. It has the characteristic Leptoclinid stiffness and opacity. The test cells are inconspicuous, but the spicules are very abundant (see Pl. XLI. figs. 5, 7). In some places they are even more numerous than is represented in figure 5. A few bladder cells are present in the outer part of the test in some places. The spicules are very regular. The rays are usually wide at the base, and curve gently upwards to the pointed apex (see Pl. XLI. fig. 6). Rarely an irregular spicule is seen like one of those shown in figure 6, where one ray is larger than the others. In some cases the rays are narrower than usual, and the apices are much sharper.

A vertical section through the colony (Pl. XLI. fig. 5) shows that below the superficial layer composed of test only (*t.m.*), occurs a wide zone (*sp.*) in which the spicules are closely placed. This region surrounds the greater part of the thorax of the Ascidiozooids. It varies somewhat in width, but is always considerably wider than the corresponding zone in *Leptoclinum carpenteri*. In the deeper parts of the colony spicules are present in the test, but they are not very numerous and are scattered evenly.

The muscles of the mantle are well developed and run in various directions (Pl. XLI. fig. 5). The branchial siphon is large, and the test lining it contains spicules (Pl. XLI. fig. 5, *br.*). The sphincter is well developed, and from its posterior edge two bands of muscle fibres arise on each side, one near the dorsal and the other near the ventral edge of the siphon. These muscle bands run posteriorly over the surface of the thorax, and soon join (see Pl. XLI. fig. 7) to form a single band which continues to run backwards

along the thorax near the dorsal edge until it reaches the œsophageal aperture, around which it curves so as to meet and join its fellow of the opposite side on the posterior surface of the œsophagus (Pl. XLI. fig. 5). From this point the single muscle band runs downwards into the test below the Ascidiozooid, where it gradually spreads outwards and ends. In all probability this is a retractor muscle for drawing the anterior end of the Ascidiozooid downwards into the colony. It would probably also compress the branchial sac so as to expel the contained water, and would at the same time help to tighten the branchial sphincter, with which it is continuous anteriorly.

Sections of this retractor muscle are met with occasionally in sections of the test (Pl. XLI. fig. 5), and more rarely short ectodermal vessels with dilated bulbous ends are seen. The latter form of appendage is very short in this species. It springs from the region of the œsophageal aperture, and runs posteriorly or dorsally (Pl. XLI. figs. 5, 7, *v.*)

The branchial sac is short and wide. Its dorsal edge is straight, and its ventral edge is curved. The stigmata are large. They are not quite so numerous as in *Leptoclinum carpenteri*. The ciliated cells are distinct; and they are columnar in shape. The endostyle is particularly large and convoluted (Pl. XLI. fig. 7, *en.*). The dorsal languets are few but large. They are of elongated triangular form.

The œsophagus arises at the dorsal edge of the posterior end of the branchial sac, and at first runs dorsally so as to pass through the loop formed by the two branches of the retractor muscle (Pl. XLI. figs. 5, 7, *œ.*). It then turns posteriorly to open into the large fusiform stomach. Transverse sections show the stomach as a simple circular cavity without any ridges or other thickenings on its wall. The intestine is narrow and simple. It lies alongside the stomach and œsophagus, and consequently the intestinal loop is narrow.

Sections of the large rounded testis were found in some of the Ascidiozooids, but no ova and no embryos were discovered in any part of the colony.

Leptoclinum edwardsi,[1] n. sp. (Pl. XXXIX. figs. 12–15).

The Colony is of irregular form, and is attached by the whole of the lower surface. The upper surface is convex and moderately smooth. The colour is grey.

The length is about 3 cm., the breadth is 7 mm., and the thickness is about 3 mm.

The Ascidiozooids are fairly large and numerous. They are distributed evenly over the surface, and do not form definite systems. A few common cloacal apertures are present. The body of the Ascidiozooid is placed vertically in the test, and is divided into two regions, thorax and abdomen.

The Test is firm but not hard. It is of a warm greyish colour, and is nearly opaque. The matrix is densely crowded with large granular test cells and with calcareous

[1] Named in honour of the late Professor H. Milne-Edwards who founded the genus *Leptoclinum*.

spicules. A few bladder cells are present in some parts of the test. The spicules are large and rather irregular in shape. They are mostly stellate, but the rays are often of different sizes and of irregular form.

The Mantle is strong. Both longitudinal and transverse bands are present.

The Branchial Sac has four rows of small stigmata. The transverse vessels are wide, and have muscle fibres.

The Tentacles are numerous, they are of two sizes, and are placed alternately.

Locality.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47° F.

Several small colonies of this species were dredged at Station 142, to the south of the Cape of Good Hope; the two largest are figured (Pl. XXXIX. figs. 12, 13). They are of irregular form and are attached to worm tubes, Polyzoa, and other objects which they have grown completely around. The colonies are of considerable thickness for their size. They are quite opaque, and are of a warm grey colour with a slight yellowish tinge in places.

The Ascidiozooids show externally as small circular lighter coloured dots (Pl. XXXIX. figs. 12, 13) less than 0·5 mm. in diameter. The common cloacal apertures are slit-like, and are rather more than 1 mm. in length.

The test cells are unusually large and conspicuous. They are mostly of rounded forms and are very granular. The spicules are irregular in shape, size, and distribution (Pl. XXXIX. fig. 15). As a rule, however, they are more abundant in the surface layer of test than deeper down. They are not arranged so as to mark out Ascidiozooid areas as they are in *Leptoclinum tenue* and some other species. The spicules even in the surface layer of the test are not so numerous as they are in most colonies of the Didemnidæ.

The branchial sac is fairly large. At its posterior end there is a part of its wall lying behind the fourth row of stigmata, and about equal to two rows of stigmata in breadth, which is not pierced by any apertures (Pl. XXXIX. fig. 14). The stigmata are short, some of them are nearly circular, and they are sometimes placed irregularly. The ciliated cells are distinct. The muscle bands in the transverse vessels are unusually strong (Pl. XXXIX. fig. 14, *tr.*). There are usually eleven or twelve stigmata in the widest row. In one sac examined there were five rows on each side, but some of the stigmata were irregular. The branchial siphon is small, but the sphincter is fairly strong.

The endostyle is long and narrow. Its course is straight (Pl. XXXIX. fig. 14, *en.*) The tentacles are rather large and numerous.

The alimentary canal is moderately large. It forms a long narrow loop. The stomach is small. The rectum contains dark-coloured fæcal pellets. It crosses the abdomen and lower part of the thorax obliquely from the ventral to the dorsal edge.

Leptoclinum japonicum, n. sp. (Pl. XXXIX. figs. 1–7).

The Colony is massive and of rudely ellipsoidal form. It was attached by a rather small concave area on the lower surface. The upper surface is strongly convex. It is even and fairly smooth. The colour is a dark greyish-brown.

The length is 1·4 cm., the breadth is 2·2 cm., and the thickness is 7 mm.

The Ascidiozooids are small and very numerous. They are scattered evenly all over the surface of the colony. No common cloacal apertures are present. The bodies of the Ascidiozooids are rather short, they are divided into two regions, the thorax and the abdomen.

The Test is firm but not hard. It is of a greyish-brown colour and nearly opaque. The matrix is densely crowded with test cells, and contains also calcareous spicules. Bladder cells are present in some places. The spicules vary greatly in size and shape, and are only present in the upper layer of the colony.

The Mantle is moderately strong. The muscle bands are narrow but regular.

The Branchial Sac is well developed. There are four rows of short stigmata. The transverse vessels are moderately wide and have muscle fibres.

The Tentacles are short, and are irregular in size and arrangement.

The Alimentary Canal is not large. It forms a short wide loop.

The Reproductive Organs are conspicuous. The testis is large, and it has the long vas deferens coiled spirally around it.

Locality.—Station 233A, May 19, 1875; lat. 34° 38′ N., long. 135° 1′ E.; depth, 50 fathoms; bottom, sand.

One colony of this species was dredged off Kobé, Japan, from a depth of 50 fathoms. In external appearance it is not unlike *Leptoclinum jacksoni* from Australia, but the resemblance is merely superficial, and the colour is darker in the present species.

The colony is massive (Pl. XXXIX. figs. 1, 2). It has evidently been attached to some convex body, as the small area of attachment at the posterior end is decidedly hollow (Pl. XXXIX. fig. 2). The upper surface is smooth and rounded, and has the small Ascidiozooids distributed evenly over it. They show as small rounded spots of a lighter colour than the surrounding test (Pl. XXXIX. fig. 1).

The test is relatively large in amount. The matrix appears structureless. The test cells are very abundant and show a great variety in form (Pl. XXXIX. fig. 3, *t.c.*); fusiform, stellate and branched shapes predominate. Bladder cells, though present (Pl. XXXIX. fig. 3, *bl.*), are not very abundant.

The spicules are fairly numerous in the superficial layer of the colony, but become very scarce or disappear in the deeper parts. Figure 3 represents part of a section through the test deep down in the colony where the spicules are absent. The shape of the spicules varies very greatly (Pl. XXXIX. fig. 6). Most of them are stellate but irregular, having the rays of different sizes and shapes. Some simple forms are found

of fusiform shape,[1] or consisting of two, three, or four rays only. Deformed and monstrous spicules also occur (Pl. XXXIX. fig. 6).

The spicules in the superficial layer of test stop at a short distance from the branchial apertures (Pl. XXXIX. fig. 5), just at the bases of the six large lobes. The greater part of each lobe is free from spicules, but the margin is bordered by a single row, and the apex contains a small mass of closely placed spicules. The result of this arrangement is that the six rays or angles of the branchial apertures stretching out between the lobes are greatly emphasised, and are conspicuous in a low power view of the surface (Pl. XXXIX. fig. 5).

The musculature of the mantle is delicate but rather regular. Equidistant longitudinally running muscle bands are present on the thorax. At the anterior end they radiate from the base of the branchial siphon. The atrial siphon is placed on the dorsal edge of the thorax, half way down.

The transverse vessels of the branchial sac are provided with strong muscle bands (Pl. XXXIX. fig. 4, *tr.*). The stigmata are short, but numerous and regular. The ciliated cells are distinct (Pl. XXXIX. fig. 4, *sg.*).

The endostyle is large. The tentacles are of at least two sizes, but they are not arranged with regularity. The nerve ganglion is spherical. It is placed at the base of the branchial siphon.

The alimentary canal is rather narrow. The œsophagus leads posteriorly from the branchial sac to the small globular or quadrate smooth-walled stomach. The intestine runs posteriorly from the stomach for a short distance and then sweeps round anteriorly in a wide open loop. The rectum lies alongside the œsophagus.

The male reproductive organs are placed on the intestinal loop, behind which they project for a considerable distance, and so form the posterior end of the body. The testis is large and ovate, and the conspicuous vas deferens coils from six to eight times spirally around it (Pl. XXXIX. fig. 7, *v.d.*). No ova and no embryos were discovered in any of the Ascidiozooids examined.

Leptoclinum (?) jacksoni, n. sp. (Pl. XXXVIII. figs. 19–22).

The Colony is massive and of irregular shape. It is attached by the greater part of the lower surface, which is strongly concave. The upper surface is irregularly conical; it is fairly smooth. The colour is a dull greyish-white.

The length is 1·7 cm., the greatest breadth is 2·5 cm., and the greatest thickness is 1·2 cm.

The Ascidiozooids are small but very numerous. They are closely placed all over the

[1] Possibly these simple fusiform spicules are merely fragments of the ordinary stellate ones which have been broken off in cutting the sections.

surface, and are not arranged in definite systems. There are no common cloacal apertures visible.

The Test is very hard and firm. It is of a dull whitish colour and is opaque throughout. The matrix contains numerous test cells and calcareous spicules. No bladder cells are present. The spicules are stellate and regular, but they vary a good deal in size.

The Mantle is rather thick, and the musculature is well developed.

The Branchial Sac is small, and the stigmata are inconspicuous.

The Endostyle is very wide. Its course is somewhat undulating.

Locality.—Port Jackson, Sydney, Australia; depth, 6 to 15 fathoms.

One specimen of this species was dredged in Port Jackson, from shallow water. It is a small but massive colony, which has evidently been attached to some dome-shaped object, as there is a large hollow on the lower surface (Pl. XXXVIII. fig. 19). The area of attachment is very smooth; there are no projecting threads or tufts of test. The thickness given in the above description is measured across the base of the colony at right angles to the breadth. The distance from the point of attachment to the upper surface in the thickest place (the centre of the colony) is a little over 1 cm. The colour is a dirty cream tint; it is a mixture of white, yellow, and grey, and is quite opaque.

The Ascidiozooids are remarkably small, and are closely placed. They are not conspicuous, and show merely as minute depressions on the surface. In external appearance this species resembles *Leptoclinum japonicum* somewhat, but in that form the Ascidiozooids are much more distinct (see Pl. XXXIX. figs. 1, 2).

The test is solid and is relatively of large amount (Pl. XXXVIII. fig. 20). It is densely crowded with test cells, which are of rather large size and of various shapes (Pl. XXXVIII. fig. 21, *t.c.*). The spicules are fairly abundant in the superficial layer of test, but are scarce in the deeper parts of the colony (see Pl. XXXVIII. fig. 20). They are not arranged so as to define the Ascidiozooid areas as in some other species, but are distributed quite irregularly. The spicules vary greatly in size (Pl. XXXVIII. fig. 21, *sp.*), but are always more or less stellate in shape. In some places the matrix is distinctly fibrillated, but as a general rule it shows no structure. Large ovate or rounded granular cells are also present (Pl. XXXVIII. fig. 21, *p.c.*). These are pigment cells of a greyish-yellow colour, and they probably aid in rendering the test opaque.

The branchial siphon is small but well formed (Pl. XXXVIII. fig. 20, *br.*). The aperture is circular, and the sphincter is well developed. The musculature in general is strong. Retractor muscles are present which run downwards into the test Pl. XXXVIII. fig. 21, *v.ap.*)

The alimentary canal is small. It forms a narrow loop.

A number of large tailed larvæ were found in the colony. They are imbedded in the lower part of the test below the bodies of the Ascidiozooids. These larvæ have ellipsoidal

bodies and long tails (Pl. XXXVIII. fig. 22). The tail has a wide membranous fringe but no supporting transverse rays. About the middle of the body there are two closely placed pigmented sense organs, and three well-developed adhering papillæ are situated at the anterior end (Pl. XXXVIII. fig. 22).

Leptoclinum rubicundum, n. sp. (Pl. XXXIII. figs. 9–15).

The Colony forms an irregularly shaped and moderately flattened mass attached by a considerable part of the lower surface. The free end is rounded and slightly lobed. The surface is uneven and rough. The colour is a bright reddish-brown or rusty colour.

The length is 3·5 cm., the breadth is 2·5 cm., and the thickness is 7 mm.

The Ascidiozooids are rather small but numerous. They are scattered evenly over nearly the whole surface of the colony. The body is of rounded form, and is not distinctly divided into regions.

The Test is hard and tough. It is reddish-brown and quite opaque on the outer surface, whitish-grey and semi-translucent in the deeper parts.

The spicules are slightly yellow in colour and are stellate in form. They are of rather small size, but are abundant in the outer layers of the test. The test cells are small and rather scarce. They are usually of rounded or ovate form.

The Mantle is thin and transparent. Its musculature is rather feeble.

The Branchial Sac is moderately large and has the stigmata well developed. The transverse vessels are wide, and are provided with muscle bands. The stigmata are moderately long and are arranged with regularity.

The Endostyle is wide and conspicuous. Its course is straight.

The Tentacles are numerous but very short. There are about twenty of them; they vary in size, and are not arranged with great regularity.

The Dorsal Tubercle has a circular aperture of fair size.

Locality.—Station 149c, Balfour Bay, Royal Sound, Kerguelen Island, January 19, 1874; depth, 20 to 60 fathoms; bottom, volcanic mud.

A single specimen of this conspicuous species was collected in Royal Sound, Kerguelen Island. It is a small colony of irregularly conical form when laid on one side (Pl. XXXIII. fig. 9); and the area of attachment occupies more than half of the lower surface. The colour is peculiar. It is in most places a bright rusty brown, but in some parts it is much paler, becoming yellowish and almost white, while in others again it is darker.

Only one common cloacal aperture is visible on the upper surface. It is of elliptical form, about 2·5 mm. in length and 1 mm. across. No systems are present, the Ascidiozooids being placed at equal distances, with their centres usually about 1 mm. apart, all

over the surface (Pl. XXXIII. fig. 10). Just as in the case of *Didemnum aurantiacum*, the colour is confined to the superficial layer of the colony, where it forms a thin crust. In the present species, however, it is not the matrix alone that is coloured, as the spicules have a slight but distinct yellow tint.

The test is firm and nearly opaque even in the lower, almost colourless part of the colony. The spicules are very numerous in the upper part of the test (see Pl. XXXIII. fig. 11, *sp.*), and less abundant in the deeper parts. They are very regular in shape and size (Pl. XXXIII. fig. 12).

The Ascidiozooids, as seen in a surface view of the colony, are of elliptical or ovate shape (Pl. XXXIII. figs. 10, 11), and are inclined at an angle to the surface, so that the greater part of the ventral edge of the thorax, as well as the anterior end, is visible. The branchial aperture is usually distinctly seen (Pl. XXXIII. fig. 10, *br*) surrounded by a well-marked sphincter, and the short wide straight endostyle (Pl. XXXIII. figs. 10, 11, *en.*) is always a conspicuous object under a low power. The darker spaces between the bodies of the Ascidiozooids are formed of test containing closely-packed spicules (Pl. XXXIII. fig. 11).

The branchial sac is larger and the stigmata are more distinct (Pl. XXXIII. figs. 13, 14) than in most allied forms. The transverse vessels are regular, and the stigmata are numerous and of very fair size (Pl. XXXIII. fig. 14, *sg.*). The ciliated cells are distinct. Figure 13 on Plate XXXIII. shows part of the sac of a young Ascidiozooid where the stigmata are shorter and more rounded. In the specimen from which this figure was drawn there were no muscle fibres in the transverse vessels.

The dorsal and the ventral tentacles are longer than any of the others. The median lateral tentacles come next in size (see Pl. XXXIII. fig. 15). In each interspace between these four primary tentacles four shorter ones are usually present; these vary in length amongst themselves, and are not arranged with perfect regularity (Pl. XXXIII. fig. 15, *tn.*). It is interesting to find that the two largest tentacles in this Compound Ascidian are not in the same position as those which E. van Beneden and Julin have shown to be the first developed in the young Simple Ascidian,[1] and that the next largest pair (the medio-lateral) correspond to the pair which are developed first. The order of development in the Compound Ascidian is not known. In von Drasche's *Polycyclus violaceus* the medio-lateral tentacles are the largest.

The prebranchial zone is rudely circular in outline, the peripharyngeal bands are distinctly marked, and there is no peritubercular area (Pl. XXXIII. fig. 15). The anterior extremity of the large endostyle encroaches upon the ventral part of the prebranchial zone, carrying the inner peripharyngeal band forwards in front of it. The branchial sphincter is well developed (Pl. XXXIII. fig. 15), and a number of delicate radiating muscle bands start from its edge and run outwards and backwards over the

[1] Recherches sur le développement post-embryonnaire d'une Phallusie, *Archives de Biologie*, t. v. p. 611, 1884.

mantle. The nerve ganglion is conspicuous (Pl. XXXIII. fig. 15, *n.g.*) and is of irregularly rounded form. The aperture of the neural gland is distinct. In the specimen figured (Pl. XXXIII. fig. 15) it seemed to open posteriorly to the peripharyngeal band.

Family V. Diplosomidæ.

Colony forming a thin, incrusting layer, rarely thickened, never pedunculated.
Systems irregular, usually inconspicuous. Common cloacal apertures usually visible.
Ascidiozooids divided into two distinct regions, thorax and abdomen.
Test soft and gelatinous, usually transparent, rarely containing calcareous spicules. Vascular ectodermal appendages provided with muscle fibres.
Branchial Sac large, with four rows of stigmata.
Dorsal Lamina represented by large languets.
Alimentary Canal extending behind the branchial sac. Stomach smooth-walled.
Reproductive Organs behind the intestinal loop or on its right side. Testis forming more than one mass. Vas deferens not spirally coiled.
Gemmation pyloric. Larva gemmiparous.

The first known member of this remarkable family was *Diplosoma rayneri*, described by Dr. J. D. Macdonald in 1859[1] from a specimen obtained at Sydney, Australia. In the account of this new species and genus, Macdonald really gave the most essential characters of the family, but it was Giard who, in 1871,[2] first formally defined the Diplosomidæ. This latter author also added two new genera, *Pseudodidemnum* and *Astellium*, each containing a single species; and in 1883 von Drasche[3] described several additional species belonging to the family, and pointed out the characters and relations of the group more fully and correctly than had previously been done.

The family is evidently of small size, but seems to be widely spread in shallow water. It is more closely related to the Didemnidæ than to any other group of the Ascidiæ Compositæ. Jourdain[4] has recently proposed that these two families should be united under the name Oligosomidæ. This is quite unnecessary, as the two groups are sufficiently separated by the structure of the reproductive organs.

The colony in the Diplosomidæ forms a very delicate incrusting layer, usually attached slightly by the greater part of the lower surface, and easily removed. It never becomes massive, and is always sessile.

Both Giard and von Drasche describe the colony as formed of two thin layers of

[1] *Trans. Linn. Soc. Lond.*, vol. xxxii. p. 373.
[2] Recherches sur les Synascidies, *Archives d. Zool. expér.*, p. 654.
[3] Die Synascidien, &c., p. 38.
[4] Sur les Ascidies Composées de la tribu des Diplosomidæ, *Comptes rendus*, t. c., No. 24, p. 1512.

test, an upper and a lower, between which the bodies of the Ascidiozooids are suspended, and they emphasize this peculiarity as one distinguishing these colonies from those of other Compound Ascidians; but in all the specimens of Diplosomidæ which I have examined, the relation between the test and the Ascidiozooids of the colony is essentially the same as that found in all other Ascidiæ Compositæ. The only difference is that the test is usually extremely soft and gelatinous, and that it is considerably broken up by the presence of numerous large spaces and canals which are prolongations of the common cloacal cavities, and serve to place the atrial apertures of the Ascidiozooids in communication with the exterior. This is of course a condition which is found to a greater or less degree in most Compound Ascidian colonies, and although the result of its considerable development in the Diplosomidæ is doubtless, as described by former authors, to reduce very greatly the amount of test in the centre of the colony, and leave only the surface layers as continuous and conspicuous expansions, still it is no novel arrangement, but merely a slight modification, and the test must be regarded as a true investing mass surrounding the Ascidiozooids on all sides, just as it does in the other Ascidiæ Compositæ.

The test is usually exceedingly transparent, but in some species it contains conspicuous pigment cells. Calcareous spicules are rarely present, and are confined to the superficial layer of the test. Giard was of opinion that they were never present, and made the absence of spicules the character by means of which he distinguished the Diplosomidæ from the Didemnidæ.[1] As a general rule, it is a good distinctive feature, but it will not hold good universally, as von Drasche has described two members of the Didemnidæ, *Didemnum inarmatum* and *Didemnum tortuosum*, in which the test has no calcareous spicules, and I have added a third species, *Didemnum inerme*, which is in the same condition; while, on the other hand, von Drasche found one of the Diplosomidæ, *Diplosoma pseudoleptoclinum*, in which calcareous spicules were present in the upper layer of the test, and in a small clump on each side of the thorax of the Ascidiozooids, and in one of the species to be described below, *Diplosomoides molle*, calcareous spicules are also present. Consequently, this character breaks down as an infallible diagnostic.

The general shape and structure of the Ascidiozooid is very much like that which prevails in the Didemnidæ. The thorax is usually longer than the abdomen, and the atrial aperture is very inconspicuous. The branchial sac is of large size, and the stigmata are well developed.

The stomach is ellipsoidal, and has no folds in its wall. Its long axis generally runs dorso-ventrally, and the intestine forms rather a wide loop.

The testis is usually in the form of two large spermatic vesicles, opening into a vas deferens which is not spirally coiled. This is an important point of distinction between

[1] Recherches sur les Synascidies, &c., p. 608. Jourdain, writing quite recently (*Comptes rendus*, June 15, 1885), has returned to this incorrect view that the absence of spicules is the chief distinguishing feature of the Diplosomidæ.

the present family and the Didemnidæ, where the vas deferens always commences by coiling spirally around the single large testis.

Pyloric gemmation, which is sometimes met with in the Didemnidæ, is found typically in the Diplosomidæ, where it produces in the Ascidiozooids the curious double-bodied appearance (see Pl. XLII. figs. 7, 8) first noticed by Macdonald in *Diplosoma rayneri*. Each new Ascidiozooid produced by gemmation in the colony is formed by the union of two distinct buds, which either arise independently from the body of the parent, or separate very soon after their origin, the one becoming the thorax and the other the abdomen. The first process of gemmation, however, is so early that it commences in the embryo. Consequently the larva produces at least two Ascidiozooids in place of one, but all the future Ascidiozooids of the colony have their bodies formed by two distinct buds[1] in place of by one, as in the case of other Ascidiæ Compositæ.

It has been shown conclusively by von Drasche that the three genera *Diplosoma*, *Pseudodidemnum*, and *Astellium* were distinguished by Giard upon quite insufficient grounds, so that the two latter names must be given up, leaving *Diplosoma*, Macdonald, as the only genus in the family. Jourdain[2] has recently changed Giard's *Astellium* into *Brevistellium*. Both names are unnecessary and must be abandoned. The suggestion made by von Drasche[3] that the species forming thicker colonies might with advantage be separated from those which produce mere incrusting films may possibly have to be carried out, but I believe that it is more practicable in the present state of our knowledge of the group to divide the family into two genera, in the one of which the test has no calcareous spicules, while in the other spicules are present, and I would propose the name *Diplosomoides* for the latter group, leaving *Diplosoma* for the more typical members of the family, with soft transparent colonies. The species of *Diplosomoides* are obviously more nearly allied to the Didemnidæ than are those of *Diplosoma*.

Diplosomoides, n. gen.

Colony usually thin and incrusting, sometimes only slightly attached.

Test gelatinous, sometimes firm externally, more or less opaque and of a whitish colour. Calcareous spicules present in the superficial layer.

The other characters of this genus are the same as those of the following one, *Diplosoma*, the single important distinguishing feature being the presence of spicules in the test. This, however, gives rise to opacity, and produces a whitish colour in the

[1] According to Jourdain, however (*Comptes rendus*, t. c., No. 24, p. 1512), the two buds arise as a single projection, from the œsophageal region of the body, which very soon divides into two parts.

[2] *Comptes rendus*, t. c., No. 24, p. 1512.

[3] Die Synascidien, p. 39.

upper layer of the test, while it causes the colony as a whole to become firmer and more solid looking.

In this genus I place von Drasche's *Diplosoma pseudoleptoclinum* from the Adriatic, and a new species described below, which was obtained during the Challenger Expedition off the Arrou Islands. These two species differ in a number of points, including the following:—In *Diplosomoides pseudoleptoclinum* the colony is thinner, more incrusting, and decidedly firmer, the spicules are more numerous, and there is a group of spicules placed on each side of the thorax. In *Diplosomoides molle*, on the other hand, the colony is thicker, very slightly attached, and very soft and flexible, the spicules are comparatively few, and there are none alongside the thorax. The branchial sac is also relatively larger than in *Diplosomoides pseudoleptoclinum*.

Diplosomoides molle, n. sp. (Pl. XLII. figs. 5–16).

The Colony is an irregularly rounded mass, attached slightly at various points. The surface is uneven but smooth. The colour is dull white with a greyish tinge.

The length is nearly 4 cm., and the breadth is 2·5 cm. The average thickness is about 5 mm.

The Ascidiozooids are fairly large and very numerous. They are distributed evenly all over the surface of the colony, and are closely placed. Several common cloacal apertures are present. The bodies of the Ascidiozooids are from 1·5 mm. to 2 mm. in antero-posterior length and about 0·5 mm. in greatest breadth. They are distinctly divided into two regions, thorax and abdomen.

The Test is exceedingly soft and flexible; it is easily torn. It is of a greyish-white colour externally, and of a clear hyaline grey internally, and is transparent. The matrix is clear and structureless. In the superficial layer of the colony it contains great numbers of small spherical or stellate calcareous spicules, while in the deeper parts of the test no spicules are present. Test cells are very abundant, they are mostly of small size and rounded form. No bladder cells are present. Vascular ectodermal appendages are frequently met with in the test.

The Mantle is thin and transparent. The chief muscle bands run longitudinally.

The Branchial Sac is large and well developed. There are four rows of fairly large stigmata, arranged with regularity. The transverse vessels are moderately wide, and are provided with muscle fibres, which are also continued into the longitudinal interstigmatic vessels.

The Dorsal Lamina is represented by a series of long narrow languets.

The Tentacles are well developed, and are arranged with regularity. There are sixteen, and they are of two sizes, placed alternately.

The Dorsal Tubercle has a narrow slit-like aperture running antero-posteriorly.

The Alimentary Canal is of large size, and forms a wide loop. The stomach is globular and smooth-walled.

Locality.—Off the Arrou Islands, September 18, 1874.

One specimen of this interesting species was obtained off the Arrou Islands, to the south-west of New Guinea, from shallow water. It is a moderately large colony, attached slightly by part of one edge to some gravel and shell fragments, and expanding upwards into an irregularly rounded and lobed form (Pl. XLII. fig. 5).

The specimen is a good deal creased and corrugated on the surface, but that is, I believe, to a large extent the result of preservation in alcohol; in all probability when it was living and all the Ascidiozooids in the colony had their branchial sacs expanded with water, it was larger and more rounded, and the surface was more regular than is shown in the figure. From its great softness the specimen is readily deformed, and it is probably now abnormally flat from having lain on one surface in a bottle for more than ten years.

The colour is the same dull white all over the surface. It is due mainly to the superficial layer of test containing spicules. The anterior ends of the Ascidiozooids show as small, rounded, more transparent dots on the surface. They are closely placed, and are equally numerous over the whole colony. The common cloacal apertures are not numerous, and they are not conspicuous. They are of slit-like form.

The test is gelatinous, and is perfectly clear and transparent in the interior of the colony. The outer layer, however, is slightly firmer, and is of a whiter colour and less transparent. It contains numerous small spicules, most of which are spherical, with or without numerous minute spines projecting from the surface. Some, however, are stellate, with many very delicate, sharp-pointed rays (Pl. XLII. fig. 12), and intermediate forms between the stellate and the spherical spicules occur. The calcareous spicules in this colony are absolutely confined to the superficial layer, and it is this which causes the difference between the surface layer of the test and the deeper parts. The test cells are especially abundant where there are no spicules.

The mantle allows the branchial sac and the other organs to be seen distinctly through it. There are two strong muscle bands which run longitudinally down the dorsal edge of the thorax. The branchial siphon is large. It is lined by a layer of test, in which calcareous spicules are found. These spicules are usually aggregated in three distinct clumps which lie just inside the sphincter. The margin of the aperture is not lobed. The branchial sphincter is moderately developed (Pl. XLII. fig. 13).

The superficial layer of test along with the Ascidiozooids may be stripped off from the rest of the colony (see Pl. XLII. fig. 6, which represents such a piece removed from the colony, and seen from the lower surface) as the deeper layers of test are very soft and easily torn, besides being much cut up by the cavities and passages by means of which the

atrial apertures of the various Ascidiozooids are placed in connection with the common cloacal apertures. There is, however, continuous test substance around the Ascidiozooids, and not merely a lower layer by which the colony is attached, and an upper layer from which the Ascidiozooids are suspended, as has been described in the case of some of the Diplosomidæ. It is really an investing mass, just like that of any other Compound Ascidian, except that it is much softer, and is more encroached upon by the common cloacal cavities and their prolongations.

The Ascidiozooids are very distinctly divided into thorax and abdomen, and these two regions are very much of the same size. The thorax is usually rather the longer, and the abdomen the broader of the two (see Pl. XLII. figs. 6, 7, 8, 9). The thorax and abdomen are connected by a very short and narrow pedicle, consisting mainly of the œsophagus and the rectum (Pl. XLII. fig. 9). The vascular ectodermal appendages given off by the Ascidiozooids are generally two in number, one longer and one shorter (Pl. XLII. figs. 8, 9). They run posteriorly through the test, and terminate in short wide swellings or bulbs (Pl. XLII. fig. 10), on which the ectoderm cells become columnar in form (Pl. XLII. fig. 11, shows a terminal bulb in optical section).

The branchial sac is longer than it is wide (Pl. XLII. fig. 8, *br.s.*). It has in most Ascidiozooids four rows of stigmata, and there are on an average ten stigmata in each row. The musculature of the branchial sac is well developed (Pl. XLII. fig. 14, *m.f.*). A strong band runs along each transverse vessel, and gives off fibres which pass upwards and downwards into the interstigmatic vessels. As the stigmata in adjacent rows usually alternate with each other, the same muscle fibres do not pass directly upwards from an interstigmatic vessel to one above, but always interlace with the muscle fibres in the transverse band, before passing to the next row (see Pl. XLII. fig. 14). The ciliated cells on the sides of the stigmata are distinct. In the branchial sacs of young Ascidiozooids the stigmata are much smaller, and are relatively shorter (Pl. XLII. fig. 15), while the transverse vessels are wider. Two Copepoda were found in the branchial sac of one of the Ascidiozooids examined.

The endostyle is of moderate size; its course is straight (Pl. XLII. fig. 8, *en.*). The dorsal languets are long and narrow, and are nearly tentacular in form. Their bases equal in breadth the space between the two dorsal muscle bands in the mantle (Pl. XLII. fig. 16, *d.l.*). In the young Ascidiozooid examined (see Pl. XLII. fig. 15, *l.*) the languets are relatively much shorter and stouter. They evidently become elongated as they grow older.

The tentacles (Pl. XLII. fig. 13, *tn.*, *tn'.*) are large and regular. The longer ones are as a rule about twice the size of the intermediate shorter tentacles. In some cases the dorsal, the ventral, and the two median lateral tentacles are rather larger than the four remaining long ones, thus producing three orders—four primary, four secondary, and eight tertiary—alternately placed.

The nerve ganglion and neural gland form an ellipsoidal opaque mass, placed in the mantle over the prebranchial zone. The aperture of the dorsal tubercle is immediately on the ventral face of this mass, and opens between the base of the dorsal tentacle and the anterior end of the dorsal lamina. It is a longitudinally placed slit with raised edges (Pl. XLII. fig. 13, *d.t.*). There is a very slight peritubercular area, but the tubercle really occupies nearly the entire breadth of the prebranchial zone. The region bounded by the peripharyngeal band (Pl. XLII. fig. 13, *p.p.*) is nearly as wide from side to side as it is dorso-ventrally.

The œsophagus commences at the dorsal edge of the posterior end of the branchial sac, and runs backwards to open into the large globular smooth-walled stomach (Pl. XLII. figs. 7, 8, 9, *st.*). The intestine, after leaving the posterior end of the stomach, curves round ventrally and then anteriorly in a wide open loop. It runs forwards to about the level of the œsophagus, and then turns dorsally at a sharp angle to become the rectum (Pl. XLII. figs. 7, 8, 9) which crosses the œsophagus and so reaches the dorsal edge of the branchial sac. The rectum contains dark-coloured fæcal pellets.

The reproductive organs were not well developed in any of the Ascidiozooids examined; but many of them showed buds in various stages of development (see Pl. XLII. figs. 7, 8). The method of budding is that first described by Macdonald, and since called pyloric budding by Giard. The thorax and the abdomen of the new Ascidiozooid arise as distinct buds[1] from the body of the parent (Pl. XLII. fig. 7, *br.s'.* and *st.*, *i'.*).

Diplosoma, Macdonald.

Didemnum, Milne-Edwards, Observations, &c., 1841.
Diplosoma, Macdonald, Trans. Linn. Soc. Lond., vol. xxxii. p. 373, 1858.
Diplosoma, *Pseudodidemnum*, and *Astellium*, Giard, Recherches, &c., 1871.
Pseudodidemnum, *Astellium*, Della Valle, Contribuzioni, &c., Napoli, 1877.
Diplosoma, von Drasche, Die Synascidien, 1883. In part.
Diplosoma, *Pseudodidemnum*, and *Brevistellium*, Jourdain, Comptes rendus, t. c. p. 1512, 1885.

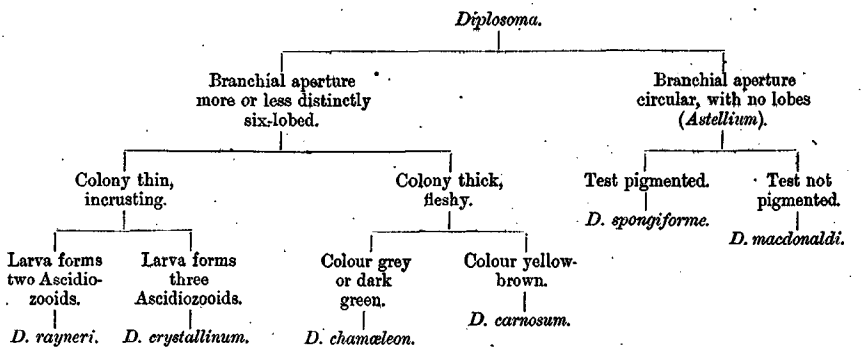
Colony usually thin and incrusting, rarely thick.
Systems irregular. Common cloacal apertures rounded.
Ascidiozooids divided into thorax and abdomen.
Test soft and gelatinous, usually transparent, sometimes pigmented, never with calcareous spicules.
Branchial Sac large, with four rows of stigmata.
Alimentary Canal moderately large. Stomach ellipsoidal and smooth-walled.
Reproductive Organs close to the intestinal loop. Vas deferens straight.
Gemmation pyloric. Larva gemmiparous.

[1] Possibly the two buds may have a common origin from the œsophageal region, such as Jourdain has described in the case of *Diplosoma* (*Brevistellium*) *spongiforme* (*Comptes rendus*, t. c., No. 24, p. 1512, 1885).

This genus contains the typical members of the family, with clear soft gelatinous colonies, like Macdonald's *Diplosoma rayneri* and Giard's *Pseudodidemnum crystallinum* but it also includes those species, like von Drasche's *Diplosoma carnosum*, where the colony becomes thick and fleshy; in none of them, however, are calcareous spicules ever developed in the test. The other characters are merely those of the family, which have already been sufficiently discussed.

In the living condition colonies of this genus are most beautiful objects, and on account of their wonderful transparency they allow a great deal of the anatomy of the Ascidiozooids to be made out without cutting into the test. The common cloacal apertures are also clearly visible in the living and expanded condition of the colony. They are circular apertures with very slight lobes or none at all, but often pigmented round the margin, and are placed on delicate conical processes from the surface of the colony. In spirit-specimens the common cloacal apertures are very rarely visible, and the limits of the irregular systems are difficult to determine.

Six species of *Diplosoma* are known with certainty. These are Macdonald's *Diplosoma rayneri*, Giard's *Pseudodidemnum crystallinum*, Giard's *Astellium spongiforme*, von Drasche's *Diplosoma chamæleon*, von Drasche's *Diplosoma carnosum*, and the new species *Diplosoma macdonaldi*. Milne-Edwards' *Didemnum gelatinosum* belongs to the genus, and may either be the same as *Pseudodidemnum crystallinum*, Giard, or a distinct species. Again, Della Valle's *Pseudodidemnum listerianum* may be *Diplosoma chamæleon* or a distinct species. Jourdain's *Pseudodidemnum zosterarum* has not yet been described; it may be merely a synonym. Leaving out these doubtful species, the genus may be divided as follows:—



Diplosoma macdonaldi, n. sp. (Pl. XLII. figs. 1–4).

The Colony is a thin spreading layer of irregular shape, slightly attached by parts of its lower surface. The upper surface is uneven but smooth. The colour is grey.

The length is about 2·5 cm., and the greatest breadth is 1 cm.; the thickness is about 1 mm.

The Ascidiozooids are moderately large and numerous. They are scattered irregularly over the surface of the colony, and are not arranged in definite systems. No common cloacal apertures are visible. The bodies of the Ascidiozooids are about 1·5 mm. in antero-posterior length and 0·5 mm. in greatest breadth; they are divided into two regions, thorax and abdomen.

The Test is very soft and flexible. It is of a clear grey colour and quite transparent. The matrix is slightly fibrillated in places, and contains large numbers of bladder cells and test cells of various kinds. No calcareous spicules are present. Many of the test cells are of large size (0·075 mm. in diameter) and of rounded form. They are coarsely granular.

The Mantle is rather thin and membranous. Its musculature is feeble.

The Branchial Sac is large. There are four rows of long stigmata. The transverse vessels are narrow, but they are provided with muscle fibres.

The Dorsal Lamina is represented by a series of long languets.

The Tentacles are of two sizes, placed alternately. They are about twelve in number.

The Alimentary Canal forms a wide loop. The stomach is large and smooth-walled.

Locality.—Off Bahia, Brazil, shallow water.

The small specimen for which this species is formed was found attached to a fragment of a Hydroid Zoophyte dredged in shallow water off Bahia. It is loosely attached to the branches of the Zoophyte around which it has grown (Pl. XLII. fig. 1). Its general colour is due to the Ascidiozooids, which are of an opaque grey and show distinctly, while the investing test is clear and almost colourless. The colony is exceedingly soft and flexible, and the outer layer of test may be readily stripped off, taking the Ascidiozooids with it, as in the case of the last species. Figure 2 on Plate XLII. represents such a preparation seen from the inner surface.

The Ascidiozooids lie at various angles to the surface, and are apparently quite irregularly placed. Their atrial apertures are connected by a system of canals and cavities which penetrate the test and greatly reduce its bulk and strength. These doubtless open at one or more points on the upper surface of the colony, but no such common cloacal apertures were discovered. The upper layer of test to which the Ascidiozooids adhere is fairly compact (Pl. XLII. fig. 2), but the lower parts are greatly vacuolated and contain

large numbers of bladder cells (Pl. XLII. fig. 3, *bl.*). In many places the bladder cells are polygonal from mutual pressure.

The test cells are of two distinct kinds: (1) the large granular cells, which are very conspicuous—these are mostly of spherical or ellipsoidal shapes, but occasionally become elongated; and (2) the ordinary small test cells, which are of fusiform, stellate, or branched shapes—these are not numerous, and are inconspicuous on account of their small size and clear protoplasm. Vascular ectodermal appendages are found here and there in the test. They have short wide terminal bulbs.

The thorax and abdomen of the Ascidiozooids are of nearly equal size, and they are not separated by a marked constriction as in the case of *Diplosomoides molle*. Some parts of the mantle are slightly pigmented, and of a brownish colour. The branchial siphon is very short, and the aperture is not lobed. The sphincter is, however, distinct. The muscle bands of the mantle are very delicate; they run in various directions. Two bands run along the dorsal edge of the thorax.

The branchial sac is longer antero-posteriorly than dorso-ventrally. The stigmata are regularly arranged, and their ciliated cells are distinct (Pl. XLII. fig. 4, *sg.*). The muscle bands in the transverse vessels are not strong, and there are no fibres present in the longitudinal interstigmatic vessels (Pl. XLII. fig. 4).

The endostyle is conspicuous; its course is straight. The dorsal languets are long and narrow. The tentacles are long; they vary a little in number, but are always of two sizes, and are arranged regularly. The nerve ganglion and neural gland form an ovate opaque mass placed not far from the branchial aperture.

The œsophagus leads backwards for a short distance from the branchial sac to the large globular smooth-walled stomach (Pl. XLII. fig. 2). The intestine curves round ventrally from the posterior end of the stomach in a wide open loop, and then crosses over to the dorsal side so as to reach the branchial sac close to the œsophagus. The intestine throughout the greater part of its length contains a series of round fæcal pellets of a brown colour (Pl. XLII. fig. 2). The stomach is also sometimes of a brown colour from the contained food matters.

The reproductive organs were not well developed in any of the Ascidiozooids examined.

Family VI. Cœlocormidæ, n. fam.

Colony massive, deeply concave on the upper surface, not attached.

Ascidiozooids large, scattered all over the surface. Branchial apertures five-lobed.

Test soft and gelatinous. Test cells numerous. Calcareous spicules present in the outer layer of the colony.

Branchial Sac large and well developed.

Dorsal Lamina represented by a series of languets.

Alimentary Canal extending beyond the branchial sac posteriorly, but not forming a distinct abdomen. Stomach smooth-walled.

Reproductive Organs hermaphrodite in the adult Ascidiozooid. Testis composed of a number of pyriform vesicles, which join a spirally coiled vas deferens.

The colony which will be described below under the name of *Cœlocormus huxley* is so remarkable in its structure, and differs so much from other Ascidiæ Compositæ, that I consider it necessary to form a new family for its reception. This family I would place, in a phylogenetic classification of the Tunicata, between *Didemnum* and *Pyrosoma*, so as to lie on the outskirts of the Ascidiæ Compositæ, leading in the direction of the Ascidiæ Salpiformes.

The colony in the only species known is massive, and is so deeply concave on the upper surface as to be cup-shaped or almost tubular (Pl. XXXVII. fig. 2, and Pl. XXXVIII. fig. 1). It is not attached, but was probably not free-swimming. There is only one common cloacal aperture in the single colony, and it is placed at the bottom of the central cavity (see fig. 10, B, p. 320). From this cloacal aperture canals spread through the test, and connect the atrial apertures of the various Ascidiozooids.

The branchial apertures are pentagonal or surrounded by five short lobes (Pl. XXXVIII. figs. 2, 3). They occur not only on the outer surface of the colony but also on the inner wall of the central cavity (fig. 10, B, p. 320).

In the shape of the colony, in its free condition, and in the form of the branchial apertures, this family differs from all previously described Compound Ascidians, while in the condition of the test, the branchial sac, the dorsal lamina, and the vas deferens, it agrees with the Didemnidæ. The presence of calcareous spicules in the test, and the spiral coiling of the vas deferens, especially indicate relationship to the Didemnidæ, but it is interesting to find that although the vas deferens has the same arrangement as in the family Didemnidæ the testis is quite different, and in place of forming one large ellipsoidal mass, it is divided into a number of distinct pyriform vesicles, as in the Distomidæ or the Polyclinidæ.

The family contains the single genus *Cœlocormus*.

Cœlocormus,[1] n. gen.

Colony massive but not attached; deeply concave on the upper surface, so as to contain a large central cavity.

Ascidiozooids large, not distinctly divided into regions; branchial aperture five-lobed.

Test soft and gelatinous. Test cells numerous and large. No bladder cells. Calcareous spicules present in the superficial layer.

Branchial Sac large. Stigmata very long and narrow.

Dorsal Lamina represented by a series of long triangular languets.

Tentacles well developed.

Alimentary Canal extending beyond the branchial sac posteriorly, but not forming a distinct abdomen. Stomach smooth-walled.

Reproductive Organs not large. Ovary only present in the adult Ascidiozooid. Testis formed of a number of spermatic vesicles. Vas deferens spirally coiled.

The essential characters and relationships of this very remarkable genus have been already discussed under the definition of the family. It contains the single species *Cœlocormus huxleyi*, which was obtained in the South Atlantic, off the east coast of Patagonia.

Cœlocormus huxleyi, n. sp. (Pl. XXXVII. figs. 1–8; Pl. XXXVIII. figs. 1–4).

The Colony has the form of a kidney-shaped mass, with a large internal cavity opening to the exterior at one end. It shows no sign of having been attached. The surface is fairly smooth. The colour is a light grey.

The length is 3·5 cm., the greatest breadth is 2 cm., and the thickness is 1·5 cm.

The Ascidiozooids are large and fairly numerous. They are distributed evenly over the whole surface of the colony, and are not arranged in any definite systems. No common cloacal apertures are visible externally. The body of the Ascidiozooid is placed vertically in the colony, and is not distinctly divided into regions. The branchial apertures are conspicuous.

The Test is soft and flexible. It is of a light grey colour and is semi-transparent throughout. The matrix is in the main clear and structureless, but contains a few long delicate fibres which traverse it in all directions. The test cells are large and numerous, but not conspicuous. No bladder cells are present. Calcareous spicules are present in the outer layer of the colony, but they are not very abundant. They are stellate and fairly regular, but vary in size and in the thickness of the rays and the sharpness of their points

[1] κοίλος and κορμός.

The Mantle is fairly strong. The muscle bands are delicate but regular.

The Branchial Sac is large and well developed. The stigmata are very long and narrow. The transverse vessels are comparatively slight.

The Dorsal Lamina is represented by a series of long triangular languets.

The Tentacles are long and thin. They are numerous and of two sizes, but are not regularly arranged.

The Dorsal Tubercle has rather a large aperture.

The Alimentary Canal is fairly large, but it does not extend far behind the branchial sac. The stomach is small and smooth-walled.

The Reproductive Organs are not conspicuous. The testis is composed of a number of pyriform vesicles which join a spirally coiled vas deferens. The tailed larvæ are very large.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom temperature, 37°·2 F.; bottom, green sand.

One specimen of this interesting form was obtained from the considerable depth of 600 fathoms, off the east coast of South America. Seen from the side, the colony is distinctly reniform (Pl. XXXVII. fig. 1), having a convex upper and a concave lower surface and two rounded ends. An end view, however (Pl. XXXVII. fig. 2), shows that the mass is really hollow, being traversed throughout the greater part of its length by a large axial cavity which opens to the exterior by a terminal circular orifice about 7 mm. in diameter (Pl. XXXVII. fig. 2, and Pl. XXXVIII. fig. 1). Apparently the colony was not attached, but as there is a Polyzoon adhering to its outer surface, it was probably not free-swimming but lay on the sea-floor.

The extraordinary shape of the colony recalls the arrangement seen in *Pyrosoma*, where the Ascidiozooids and their investing mass form the walls of a hollow cylinder closed at one end. In *Pyrosoma*, however, while the branchial apertures of the Ascidiozooids open on the outer surface of the colony, the atrial apertures open on the inner surface into the axial cavity of the colony (see fig. 10, C), which is thus converted virtually into a common cloacal cavity, and the terminal aperture into the sole excretory orifice for the whole colony. In the present species this is not the case. The whole surface, both the outside of the specimen and also the lining of the axial cavity, is morphologically the outer surface of the colony, and the branchial apertures of the Ascidiozooids are found distributed all over it (see fig. 10, B). In this respect, therefore, *Cœlocormus huxleyi* presents an arrangement intermediate between that found in the typical Compound Ascidian (see fig. 10, A), where the colony is attached and more or less rounded, and the apertures of the Ascidiozooids open upon a flat or convex upper surface, and that peculiar to *Pyrosoma* (see fig. 10, C), where the colony is free-swimming, cylindrical, and has an axial cavity into which the atrial apertures of the

Ascidiozooids open independently. It is evident that although the form of the colony in the present species closely resembles that of *Pyrosoma*, still the inner surface lining the central cavity is homologous with part of the outer surface of the ordinary Compound Ascidian and not with the inner surface lining the central cavity of *Pyrosoma*. The present species is therefore to be regarded as an unattached Compound Ascidian, which shows, in the peculiar form of its colony, a transition to *Pyrosoma*.

The central cavity in *Cœlocormus huxleyi* divides about the middle of the colony into two branches which end cæcally and are separated from one another by a rounded eminence (see fig. 10, B, and Pl. XXXVIII. fig. 1) bearing on its summit a large irregularly rounded opening. This is the only common cloacal aperture visible in the specimen.

The Ascidiozooids are rather smaller and more numerous near the open end of the

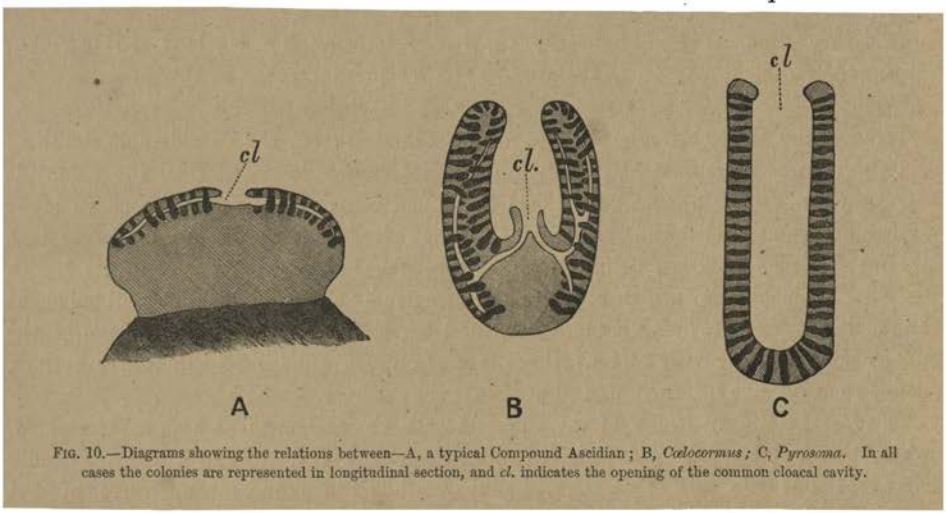


FIG. 10.—Diagrams showing the relations between—A, a typical Compound Ascidian; B, *Cœlocormus*; C, *Pyrosoma*. In all cases the colonies are represented in longitudinal section, and *cl.* indicates the opening of the common cloacal cavity.

colony than elsewhere. They are of large size and are fairly abundant about the centre, while at the closed end they are almost absent (Pl. XXXVII. figs. 1, 2), that part of the colony being mainly a mass of solid test in which some very large tailed larvæ are found imbedded. Probably the young Ascidiozooids are formed by gemmation at the open end, which is thus the growing point of the colony, and gradually move farther and farther away from the common cloaca, which may be regarded as the oldest part of the colony. The older and larger Ascidiozooids, as they approach the rounded closed end, probably die and are expelled from the colony, leaving behind them, imbedded in the test, the embryos or larvæ which they have produced during the later part of their existence. If this interpretation of the life-history of the colony is correct, the Ascidiozooids reproduce by gemmation during the early part of their existence, and sexually later on, when they are adult.

The branchial apertures are conspicuous over the greater part of the surface of the colony (Pl. XXXVII. fig. 1; Pl. XXXVIII. fig. 2). They are more regularly placed and more widely open on the inner walls of the cavity than on the outside. They are nearly circular in shape, and are surrounded by five short blunt lobes (Pl. XXXVIII. fig. 3), each of which is strengthened at its base by a clump of calcareous spicules, which forms a small opaque white dot visible to the eye (Pl. XXXVIII. figs. 2, 3).

The test is soft, and is to a great extent cut up by canals and spaces which are prolongations of the common cloacal cavity and serve to connect the atrial apertures of the various Ascidiozooids (shown diagrammatically in fig. 10, B, on p. 320). The clear matrix contains delicate fibres stretching in all directions. The test cells are large and granular; they are mostly rounded in form, but fusiform and branched shapes also occur. No spicules are present in the deeper parts of the test, and even in the superficial layers they are not very abundant. They are exactly like the spicules of a typical *Leptoclinum* (see Pl. XXXVII. fig. 4). The rays vary in thickness, but are generally very sharp at the points. No spherical forms were found.

In a section through the wall of the colony the large Ascidiozooids are seen projecting inwards from both surfaces, and occupying the greater part of the test (see Pl. XXXVII. fig. 3). The intestine, containing a row of fæcal pellets, is usually visible to the eye. It lies to a great extent alongside the branchial sac, and the thoracic and abdominal regions of the body are not distinctly separated.

The mantle is thin and transparent, but has a considerable number of muscle bands. They run mainly in a longitudinal direction, occasionally branching and anastomosing (Pl. XXXVII. fig. 5). The branchial sphincter is rather feeble. It is a narrow band of muscle, encircling the wide branchial aperture at the bases of the rounded lobes (see Pl. XXXVIII. fig. 3). The clumps of spicules which strengthen the lobes are usually placed on the line of the sphincter.

The branchial sac is large but delicate. The transverse vessels are narrow (Pl. XXXVII. fig. 6, *tr.*), and the stigmata are of great length but are arranged with regularity (Pl. XXXVII. figs. 6, 7). The ciliated cells are well developed (Pl. XXXVII. fig. 7).

The endostyle is not wide; its course is rather undulating. The dorsal languets are large. They taper to narrow points. The tentacles are very narrow, and the larger ones are of considerable length. They are closely placed round the base of the wide branchial siphon. The dorsal tubercle has a large ovate aperture immediately in front of the convoluted peripharyngeal band. The aperture leads into the usual infundibulum (Pl. XXXVIII. fig. 4, *inf.*), which rapidly tapers into a short narrow canal, leading to the neural gland (Pl. XXXVIII. fig. 4, *n.gl.*). This gland is an elongated curved body which lies along the ventral surface of the ellipsoidal nerve ganglion (Pl. XXXVIII. fig. 4, *ng.*).

The œsophagus runs posteriorly and ventrally from the branchial sac, and after a short course opens into the small, ovate, and smooth-walled stomach (Pl. XXXVII. fig. 8, *st.*). The stomach lies with its long axis dorso-ventrally. The intestine arises from its ventral end and soon turns anteriorly. It then curves round dorsally, and runs nearly parallel to the stomach and œsophagus (Pl. XXXVII. fig. 8, *i.*) until it reaches the dorsal edge of the body, where it terminates. The anus (Pl. XXXVII. fig. 8, *a*) is nearer to the posterior than to the anterior end of the body, a point in which this species agrees with *Pyrosoma* and differs from all ordinary Compound Ascidians. It is obvious that very slight change would be required to convert this alimentary canal into one agreeing with that of *Pyrosoma*, both in structure and course.

The intestine is occupied throughout the greater part of its length by a series of large dark coloured fæcal pellets, which are always a conspicuous feature (Pl. XXXVII. fig. 8). A system of branched tubules ramifies over the wall of the intestine in the middle part of its course. The various branches converge to a common duct, which leaves the wall of the intestine on its posterior edge opposite the stomach, and seems to open into the stomach, near its intestinal end.

The vas deferens is the most conspicuous part of the reproductive system. It consists of a coiled part, which forms several spiral turns, and a terminal straight portion. Several pyriform spermatic vesicles are united by very delicate ducts to the inner end of the spiral portion of the vas deferens. The ova are small and inconspicuous. They are absent in the younger Ascidiozooids, and seem to be formed late in life, and after the testes, so that there is here an approach to proterandry, a condition the reverse of that which I have found in most other Compound Ascidians. The ova form an elongated mass placed on the straight portion of the vas deferens.

No embryos were found in the Ascidiozooids examined, but some tailed larvæ of very large size are imbedded in the test near the closed end of the colony. They are of the ordinary shape, with an ellipsoidal body nearly 2 mm. in length, and a well-developed tail 4 mm. long. A single small pigmented sense-organ is present, and there are three large adhering papillæ at the anterior end of the body.

Family VII. Polystyelidæ, n. fam.

Colony massive or incrusting, sessile, rarely pedunculated, or formed of small masses connected by stolons. No common cloacal cavities present.

Ascidiozooids large, usually short-bodied, rarely with a distinct abdomen. Both apertures four-lobed, and opening directly to the exterior.

Test firm and cartilaginous. Matrix generally fibrillated, test cells small and inconspicuous, bladder cells rarely or never present. Vessels abundant, branched, and provided with distinct terminal bulbs.

Branchial Sac large and well developed. Folds sometimes present. Internal longitudinal bars strong, and fairly numerous.

Dorsal Lamina in the form of a plain membrane.

Tentacles numerous.

Alimentary Canal usually placed alongside the branchial sac, rarely extending beyond it posteriorly.

Reproductive Organs in the form of polycarps attached to or imbedded in the mantle, and projecting into the peribranchial cavity.

Gemmation effected by means of the vessels in the common test (?).

I form this family for a very interesting little group of Ascidians, the position of which is difficult to determine. I regard them as Compound Ascidians which are allied to the Cynthiidæ amongst Simple Ascidians, and have been evolved from the subfamily Styelinæ.[1] Various previously described forms must be placed here along with the new Challenger species. The history of the family is as follows:—

In 1850 Dr. Victor Carus, in a paper on the Zoology of the Scilly Isles,[2] described the genus *Thylacium*, which he considered as a Social Ascidian allied to *Clavelina*. The individual animals in his species, *Thylacium sylvani*, were connected by a common fleshy base from which they projected upwards, the body was divided into an abdomen and a thorax, and both apertures were four-lobed. Carus considered that in *Thylacium* reproduction was probably effected by gemmation as well as sexually, and he placed the *Cynthia aggregata* of Forbes and Hanley, which he also regarded as capable of reproducing by gemmation, in his new genus under the name of *Thylacium aggregatum*.

In 1863 Alder[3] gave a definition of *Thylacium*, Carus, and described two new species, *Thylacium normani*, which seems to be allied to the form described by Carus, and *Thylacium variegatum*, which differs from the other two in having the Ascidiozooids depressed and scarcely projecting from the surface of the colony. Alder does not specially mention the condition of the abdomen in this species, but I think from his general description of the body that the abdomen cannot be distinct from the thorax, and in that case this species ought not to remain in the genus *Thylacium*. I should be inclined then to remove Alder's *Thylacium variegatum* from the genus *Thylacium* and place it in Giard's genus *Synstyela*.

In 1868 Dr. J. E. Gray briefly described,[4] and figured in a woodcut, a new form which he regarded as a Social Ascidian and named *Oculinaria australis*. It was found at Fremantle in Western Australia, and formed an erect elongated colony composed of a massive test in which rounded Ascidiozooids were imbedded. The test contains imbedded sand-grains. There can be little doubt that *Oculinaria* belongs to this family, but whether it is

[1] See Summary and General Remarks at the end of this Report.

[2] *Proceedings of the Ashmolean Society*, vol. ii. p. 264, Oxford, 1843–52.

[3] *Ann. and Mag. Nat. Hist.*, ser. 3, vol. xi. p. 152.

[4] *Proc. Zool. Soc. Lond.*, vol. for 1868, p. 564.

distinct from the other known genera, and what its exact position is, cannot be determined without more information as to the structure than is given in Gray's short description.

In 1871 Dr. R. O. Cunningham, in his Report upon the collections made during the cruise of the "Nassau,"[1] described a remarkably large Ascidian from the Strait of Magellan under the name of *Goodsiria coccinea*. This species, which Cunningham regarded as a Social Ascidian, forms an elongated massive colony, sometimes more than 2 feet in length. The rounded Ascidiozooids are imbedded in the test, and are not divided into thorax and abdomen. I have examined the "Nassau" specimens in the British Museum, and the species was obtained again by the Challenger, consequently this form is well known to me. It is certainly distinct from the genus *Thylacium*, and it cannot be compared with the imperfectly known *Oculinaria*. *Goodsiria* may therefore be retained provisionally as a distinct genus, although it ought to be remembered that it may possibly be identical with *Oculinaria*, Gray.

Giard in 1874 described[2] two new genera of Ascidians from the French coast, *Polystyela* and *Synstyela*, which he regarded as being allied not to the Social Ascidians (Clavelinidæ), but to the Cynthiidæ and especially to the genus *Styela*. *Polystyela lemirri* is an incrusting species consisting of a common basal part above which the Ascidiozooids project to a height of from 4 to 6 mm. In this respect it agrees with the genus *Thylacium*, and Giard does not point out any differences between the two forms. As, however, Giard was acquainted with Carus's genus, the probability is that the two are distinct, and that *Polystyela* differs from *Thylacium* in having no distinct abdomen in the Ascidiozooids. Giard was of opinion that reproduction by gemmation was probably carried on, but he had not determined the matter conclusively. The second genus, *Synstyela*, is characterised by having the Ascidiozooids depressed and not projecting above the upper surface of the colony. Alder's *Thylacium variegatum* would therefore, as was suggested above, naturally find a place in this genus. Giard speaks of his species as being of a red colour, while Alder's *Thylacium variegatum* is shaded with flesh colour and red: possibly they may be the same species. If so, it should be called *Synstyela variegata* (Alder).

Heller,[3] writing in 1877, divided the family Cynthiidæ into two groups—the Monocynthiæ, including all the ordinary Cynthiidæ, and the Polycynthiæ, comprising the three genera *Thylacium*, *Polystyela*, and *Synstyela*. He therefore included these forms amongst the Simple Ascidians. Since that date no further attempt has been made to classify this curious little group of Ascidians.

There can be no doubt that the family Polystyelidæ is allied to the Styelinæ amongst Simple Ascidians, and especially to the genus *Polycarpa*, Heller. The condition of the test in some forms, the shape of the Ascidiozooid in others, and the structure of the

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 465.
[2] *Assoc. franç.*, Lille, 1874, p. 432.
[3] Untersuchungen über die Tunicaten des Adriatischen und Mittelmeeres, Abth. 3, Wien.

branchial sac in all, and still more the condition of the reproductive organs, show such a close resemblance to the corresponding parts in species of *Polycarpa* and *Styela*, that the two groups must be closely related, as was supposed by Giard and by Heller. But still it is impossible to regard the Polystyelidæ as Simple Ascidians. *Thylacium*, *Oculinaria*, and *Goodsiria* were all originally described as Social Ascidians allied to *Clavelina*, which produces buds. Carus and Giard both came to the conclusion that reproduction by gemmation probably took place in the genera they described, and although, like them, I have not been able to settle the matter conclusively, I think there can be very little doubt that the specimens I have examined are true colonies produced by a process of gemmation from the vascular appendages of a single Ascidiozooid.

It is well known that some species of the Styelinæ (*e.g.*, *Styela grossularia*) under certain circumstances produce aggregations which have a superficial resemblance to colonies. When individuals are closely crowded together their tests unite to form a continuous mass, and young individuals of the same species attach themselves to the tests of the older specimens. These aggregations, however, are not colonies. There is no reproduction by gemmation, the individuals in the mass have all been produced from ova, and have no relation to one another except as near neighbours, and finally they are imbedded in a common test or investing mass.

The specimens of the Polystyelidæ in the Challenger collection are not mere aggregations of individuals, they are colonies of Ascidiozooids imbedded in a common test which is penetrated by a system of vessels—consequently they must be regarded as Compound Ascidians. They are not, however, closely allied to most of the other Compound Ascidians, but have, I am inclined to believe, been evolved separately from the Simple Ascidians, and not from the end of that group occupied by *Clavelina* and *Ecteinascidia*, to which some of the Compound Ascidians are closely allied,[1] but from near the genus *Polycarpa* amongst the Cynthiidæ. The only other family of Compound Ascidians to which the Polystyelidæ seem to be closely allied is the Botryllidæ. The general shape of the Ascidiozooids, the appearance and course of the alimentary canal, and the structure of the branchial sac, are so similar in the two families, that I believe the Botryllidæ to be more nearly related to the Polystyelidæ than they are to the rest of the Compound Ascidians.

The chief characteristics of the Polystyelidæ are the large and usually rounded Ascidiozooids, with their four-lobed apertures, and the total absence of common cloacal cavities, the possession of branching vessels like those of the Botryllidæ in the test, the presence of numerous strong internal longitudinal bars, and sometimes of folds, in the branchial sac, and the simple condition of the dorsal lamina.

The shape of the colony varies greatly. It is massive and pedunculated in *Goodsiria placenta*, massive and sessile in *Goodsiria coccinea*, incrusting in *Synstyela incrustans*, and broken up into small pieces united by irregular stolons in *Chorizocormus*.

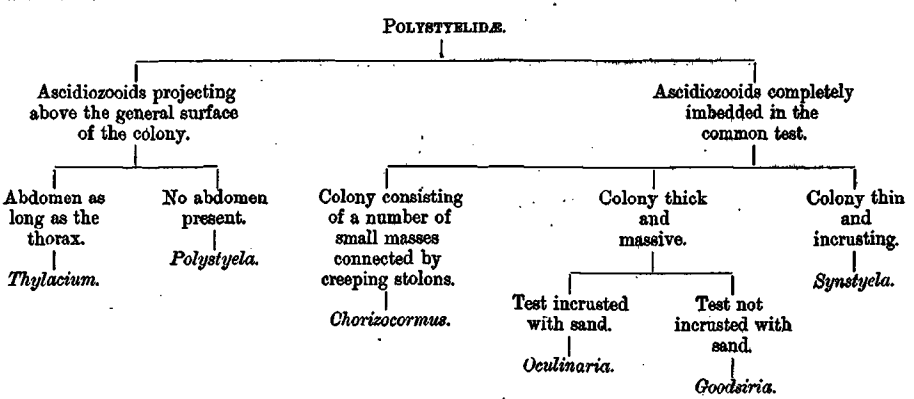
[1] See Summary and General Remarks at the end of this Report.

A distinct abdomen is present in the Ascidiozooid only in the genus *Thylacium*, Carus, so far as is known. In all other members of the family the alimentary canal lies alongside the branchial sac as it does in the Botryllidæ and in most of the Simple Ascidians. In some cases (*e.g.*, *Synstyela incrustans*) the test may be prolonged beyond the Ascidiozooids to form a spreading margin to the colony, in which numerous vessels ramify and terminate in dilated bulbs. It is probably in connection with these terminal bulbs that young Ascidiozooids are formed.

The branchial sac is always large. When longitudinal folds are present (*e.g.*, *Goodsiria placenta*) they are in the rudimentary condition[1] so frequently found amongst the Styelinæ. In some cases (*e.g.*, *Goodsiria coccinea*) there are no folds in the branchial sac. Dorsal languets are never present in the family.

The reproductive organs are present on both sides of the body in the form of little "polycarps" or masses of ovaria and spermaria partly imbedded in the mantle, and projecting into the peribranchial cavity just as in the species of *Polycarpa*. The curious "endocarps" of unknown function, which have previously only been known from the Styelinæ, are also present on the mantle of some if not all species of the Polystyelidæ (*e.g.*, *Synstyela incrustans*, see Pl. XLVI. fig. 14). In some cases the polycarps are hermaphrodite (*e.g.*, *Goodsiria placenta*), as they are in the Simple Ascidians, while in other cases they are unisexual (*e.g.*, *Goodsiria pedunculata* and *Synstyela incrustans*, Pl. XLVI. figs. 12, 13), and the male and female polycarps differ somewhat in appearance.

The genera[2] which belong to this family may be distinguished by the following characters:—



[1] See Herdman, On Individual Variation in Simple Ascidians, *Trans. Lit. and Phil. Soc. of Liverpool*, vol. for 1882.

[2] It is possible that the genus *Pyura*, founded by Blainville for an animal discovered by Molina (Saggio sulla Storia naturale del Chili, 1782), and since found by Cunningham (Notes on the Natural History of the Strait of Magellan, Edinburgh, 1871, p. 430) on the shores of the Bay of Arauco, and described as being a "Social Ascidian," belongs to this family. But the little that is known of its structure is not sufficient to determine its position with any certainty.

These are all old genera with the exception of *Chorizocormus*, which is formed for the reception of a new species collected by the Challenger Expedition at Kerguelen Island. It is allied to *Synstyela*, but differs from that genus in having the colony broken up into a number of distinct pieces united by stolons, in place of forming a continuous incrusting layer.

The Challenger Polystyelidæ represent three out of the six genera in the above table, viz., *Goodsiria*, Cunningham, *Synstyela*, Giard, and *Chorizocormus*, Herdman. There are five species, four of which are new to science, in the collection.

Goodsiria, Cunningham.

Goodsiria, Cunningham, Trans. Linn. Soc. Lond., vol. xxvii. p. 465, 1871.

Colony massive, sessile or pedunculated, not incrusted with sand.

Ascidiozooids large and ovate in shape, completely imbedded in the common test; not divided into thorax and abdomen. Apertures four-lobed, both on the anterior end.

Test solid, cartilaginous, not sandy. Matrix delicately fibrillated. Vessels present.

Branchial Sac well developed; folds present, rudimentary, or absent; internal longitudinal bars always present.

Dorsal Lamina in the form of a plain membrane.

Alimentary Canal not prolonged behind the branchial sac. Stomach folded longitudinally.

Reproductive Organs in the form of polycarps.

This genus was founded by R. O. Cunningham in 1871 for a large species, *Goodsiria coccinea*, which was obtained in the Strait of Magellan and at the Falkland Islands during the cruise of the "Nassau" between 1866 and 1869. Cunningham's description[1] refers only to the external characters, so I have supplemented it by the necessary details of the internal structure.

The colonies of this genus form large masses which may be disc-shaped, pyriform, or elongated. They are sometimes sessile (*Goodsiria coccinea*), and in other cases shortly pedunculated (*Goodsiria placenta*), while in one of the specimens of *Goodsiria pedunculata* a very long peduncle is present. The area of attachment is always small.

Cunningham has figured the short-bodied ovate or flask-shaped Ascidiozooids with the alimentary viscera placed alongside the branchial sac, a character which distinguishes this genus from *Thylacium*, Carus. The Ascidiozooids are completely imbedded in the test, which forms a thick solid mass. Bladder cells are never present in the test, and the usual test cells are small and inconspicuous. The vessels branch and terminate in dilated bulbs.

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 465.

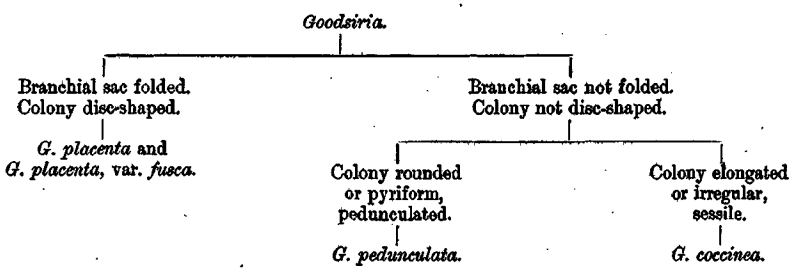
The mantle is fairly muscular, and is in some cases pigmented. Transverse, longitudinal, and oblique muscle bands are usually present.

The branchial sac is large and well developed. Longitudinal folds are present in *Goodsiria placenta*, in some cases rudimentary in *Goodsiria placenta*, var. *fusca*, and altogether absent in *Goodsiria pedunculata* and *Goodsiria coccinea*. These folds are singularly like those of some of the Styelinæ amongst the Ascidiæ Simplices.

The internal longitudinal bars of the branchial sac are always strong and conspicuous in the genus, but the transverse vessels and the stigmata vary very considerably in size in the different species. The tentacles are always numerous and well developed. Languets are never present on the dorsal lamina.

The polycarps may project freely from the mantle or be deeply buried in its substance. They are hermaphrodite in *Goodsiria placenta* and *Goodsiria coccinea*, and unisexual in *Goodsiria pedunculata*. Young Ascidiozooids are probably produced in the dilated ends of the vessels in the test, but I have not been able to find any buds.

The genus may be divided in the following manner :—


Goodsiria.
Branchial sac folded. Colony disc-shaped.
G. placenta and G. placenta, var. fusca.
Branchial sac not folded. Colony not disc-shaped.
Colony rounded or pyriform, pedunculated.
G. pedunculata.
Colony elongated or irregular, sessile.
G. coccinea.

Goodsiria coccinea is an old species, the others are new to science. This genus has only been found off the southern ends of Africa and South America.

Goodsiria placenta, n. sp. (Pl. XLIII. figs. 1–10; Pl. XLIV. figs. 4, 8–10).

The Colony is a large discoid mass attached by a short peduncle which projects from one edge. It is rudely circular in outline. The edge opposite to the peduncle is the thinner. The two sides are nearly equally flattened. The surface is not quite even and is slightly roughened. The colour is a pale grey with a slightly pinkish tint in some places. The peduncle is dark brown.

The total length is about 7 cm., the breadth is about 8 cm., the thickness is from 2 to 3 cm., and the length of the stalk is from 2 to 3 cm.

The Ascidiozooids are large and fairly numerous. They are evenly distributed over the surface of the colony, where their anterior ends show as slightly darker areas of

circular or elliptical form marked by the distinct branchial and atrial apertures. Both apertures are more or less distinctly four-lobed. The bodies of the Ascidiozooids are slightly elongated antero-posteriorly, and are about 6 or 7 mm. in length. They are placed vertically in the colony, and are not divided into regions.

The Test is firm and cartilaginous. In sections it is whitish-grey with a slight hyaline tint, and is semi-transparent. The outer layer is much firmer and tougher and more opaque than the rest. The matrix is seen, when highly magnified, to be delicately fibrillated. No bladder cells are present. Vessels are well developed in the test, and especially in the peduncle. The vessels branch and anastomose freely, and terminate in ovate or irregular swollen bulbs.

The Mantle is moderately strong. The muscle bands are delicate but numerous; they run in all directions.

The Branchial Sac is large and well developed. There are three folds upon each side. Each fold has about four internal longitudinal bars upon each side, and there are two bars in the interspace. The meshes are elongated transversely, and contain each about three stigmata. The transverse vessels are very wide, and are all of about the same size. The stigmata are short and wide. Muscle fibres are present in some cases; they are usually in the transverse vessels.

The Endostyle is large and conspicuous. Its course is straight.

The Dorsal Lamina is a plain membrane with well marked ribs corresponding to the transverse vessels of the branchial sac, but with no marginal teeth or processes.

The Tentacles are numerous and closely placed. There are about fifty, and they are of two sizes placed alternately.

The Dorsal Tubercle is small and inconspicuous. It is placed on the ventral surface of the large dark neural gland.

The Alimentary Canal is placed alongside the branchial sac. It is directed transversely. The stomach is ovate and has its wall longitudinally folded. The intestine is narrow, and forms a moderately wide loop.

The Reproductive Organs are in the form of polycarps imbedded in the mantle, and projecting into the peribranchial cavity. Each polycarp is hermaphrodite. The ducts terminate on a prominent papilla.

Locality.—Simon's Bay, Cape of Good Hope; depth, 10 to 20 fathoms.

Two large specimens of this interesting species were dredged in Simon's Bay at the South end of Africa, from a depth of 10 to 20 fathoms. They are irregularly discoid masses, which were probably attached in a vertical position, the short peduncle being a

projection from one edge of the disc (Pl. XLIII. fig. 1). The exact dimensions of the two colonies are as follows :—

	A.	B.
Length,	6·5 cm.	7·0 cm.
Breadth,	7·3 „	8·3 „
Thickness,	3·0 „	2·0 „
Length of peduncle,	2·0 „	3·0 „
Average thickness of peduncle,	1·0 „	1·5 „

The thickness gradually diminishes from the point where the stalk is attached to the opposite end, which was probably the upper edge of the colony. The peduncle rapidly tapers downwards from the point where it joins the disc to a small irregularly shaped area of attachment (Pl. XLIII. fig. 1). The colour is on the whole a pale slate-grey. The anterior ends of the Ascidiozooids have more of a dull bluish tint, and the investing mass between them is whiter. The peduncle is of an earthy brown colour, and is strongly wrinkled transversely (Pl. XLIII. fig. 1).

The Ascidiozooids are conspicuous externally over the greater part of the surface. The rounded areas visible vary from 1 to 6 mm. in length; the general size is 4 mm. As a rule they are larger at the lower edge of the colony near the peduncle, and smaller at the opposite end (Pl. XLIII. fig. 1). This is exactly what would be expected if the young Ascidiozooids were formed at the upper free end of the colony, and is the reverse of the condition found in *Colella*, amongst the Distomidæ, where the new Ascidiozooids are added to the base of the colony.

In some places the apertures are distinctly four-lobed, in others they are circular, and sometimes they appear irregular; when they are widely open they are always circular in outline. In an Ascidiozooid which appears on the surface as 4 mm. in diameter, the apertures are about 2 mm. apart (Pl. XLIII. fig. 1).

A section through the colony (Pl. XLIII. fig. 2) shows that the Ascidiozooids occupy only an outer zone which takes up about one-third of the thickness, leaving a central region formed of test only. The Ascidiozooids are of rounded or ellipsoidal form, and vary considerably in antero-posterior length; all sizes from 4 to 8 mm. are common (Pl. XLIII. fig. 2). The body is nearly equally wide throughout its length, and there is no division into thorax and abdomen.

The test is solid and massive; in the interior of the colony, although firm, it is not at all hard; it has an elastic feeling, and is moderately tough. The minute fibrillation extends through the test matrix in all directions. The test cells are small and not numerous. They are mostly of rounded forms. The vessels are a conspicuous feature in sections of the test. They are mostly of small calibre, but they branch frequently (Pl. XLIII. fig. 3) and their terminal swollen bulbs are large.

The musculature of the mantle is moderately strong. The numerous fine muscle bands form a close network (Pl. XLIV. fig. 9, *m.*). The sphincters are well developed,

and large numbers of delicate muscle bands radiate from the two siphons (Pl. XLIII. fig. 10, *m.*).

The branchial sac is thin-walled. The stigmata are short, and in some places, especially near the dorsal edge (see Pl. XLIII. fig. 4), are reduced almost to rounded openings. The folds are narrow, but well marked (Pl. XLIII. fig. 4, *br.f.*). They are exactly like those of many species of the Styelinæ amongst Simple Ascidians. The internal longitudinal bars are regular, but have no papillæ. The transverse vessels vary somewhat in width, but the sizes are not arranged with regularity. In some places slight horizontal membranes are present for short distances. They are best seen alongside the dorsal lamina (Pl. XLIII. fig. 4, *tr.*).

There is a good deal of irregularity in some of the branchial sacs. In some places several small stigmata occur between two adjacent transverse vessels, and occasionally monstrous stigmata are seen which have been formed by the junction of several ordinary stigmata (Pl. XLIII. fig. 4). The meshes are fairly regular in size, and there are three rows in each of the ordinary interspaces. Between the first fold on each side and the dorsal lamina there are only two rows of meshes, one of the usual size, and the other, next the dorsal lamina, twice the ordinary size and containing about six stigmata (Pl. XLIII. fig. 4). Next to the endostyle a row of meshes of the usual size occurs.

The dorsal lamina (Pl. XLIII. fig. 4, *d.l.*) is narrow and has a smooth edge. The ribs on its sides are continuous with the horizontal membranes of the transverse vessels.

The tentacles alternate in size with regularity. They are so closely placed that their bases touch (Pl. XLIII. fig. 10, *tn*, *tn'*). At the base of the atrial siphon, where the invaginated layer of test ends, there is a slight ridge which bears a series of small tentacles projecting freely into the peribranchial cavity (Pl. XLIII. fig. 10, *at.tn.*). These atrial tentacles are much smaller than the ordinary or branchial tentacles, and there are only twelve of them. The position of the atrial tentacles in relation to the atrial siphon corresponds exactly to the position of the branchial tentacles at the base of the branchial siphon, but their use at the entrance to the peribranchial cavity is not obvious. It has been observed in some Simple Ascidians that the current of water which usually flows in at the branchial aperture and out at the atrial is occasionally reversed for a short period, the atrial aperture becoming inhalent. Possibly in the present species this habit may have become so marked as to have favoured the development of a circle of atrial tentacles which would act as tactile organs waving in the current of water entering the animal. In one of the new Simple Ascidians (*Bathyoncus mirabilis*) obtained during the Challenger Expedition, there are two circles of small atrial tentacles developed.[1] These resemble the atrial tentacles of the present species in size and shape.

The nerve ganglion and neural gland together form an elongated ellipsoidal mass,

[1] See this Report, Part I. (in vol. vi., 1882), p. 167, pl. xxiv. fig. 12.

stretching from the base of the branchial tentacles more than half-way to the base of the atrial siphon (Pl. XLIII. fig. 10, *n.g.*). The peripharyngeal band is regular. It forms a slight peritubercular area on the dorsal edge.

The layer of test lining the atrial siphon is thrown into a series of corrugated ridges, about twelve in number, and leading downwards from the edge of the obscurely four-lobed aperture to the circle of atrial tentacles (Pl. XLIII. fig. 10, *at.*).

The œsophageal aperture is placed far back on the dorsal edge of the branchial sac. The œsophagus is a short curved tube which turns ventrally and leads into the narrow dorsal edge of the stomach (Pl. XLIII. fig. 6, *œ, st.*). The long axis of the stomach lies dorso-ventrally. On its anterior wall, near the intestinal end, there is a short cæcum (Pl. XLIII. fig. 8, *ves.*) which receives two ducts, one coming from each side of the intestine, where they branch into a large number of delicate tubules. The intestine on leaving the ventral edge of the stomach runs ventrally for a short distance and then turns anteriorly and dorsally in a wide curve. It runs parallel to the stomach and œsophagus till it reaches the dorsal edge of the body, and then turns sharply forwards to become the rectum (Pl. XLIII. fig. 6, *r.*), which runs for a short distance anteriorly along the dorsal edge of the branchial sac and ends in an anus with a slightly thickened border (Pl. XLIII. fig. 6, *a.*). Figure 5 represents on a smaller scale the alimentary canal of an Ascidiozooid where the axis of the stomach and of the middle portion of the intestine were not dorso-ventral in direction (their usual condition), but were inclined ventrally and posteriorly (compare figs. 5 and 6 on Pl. XLIII.).

The longitudinal folds on the stomach are regular and closely placed. They are from fifteen to twenty in number. A typhlosole is present in the intestine. The system of glandular tubules on the intestine is well developed (Pl. XLIII. figs. 7, 8, *h.t.*), and extends up the rectum to the anus. The tubules branch freely, and their ends form ovate dilated bulbs. They join to form a large duct on each side of the middle portion of the intestine, and these ducts open into the rounded projection on the anterior edge of the stomach (Pl. XLIII. fig. 8, *ves.*). The posterior edge of the stomach-wall is connected with the mantle externally by a large blood-vessel (Pl. XLIII. fig. 6).

The reproductive organs are imbedded in the mantle (Pl. XLIV. figs. 4, 8, 9), and form thickenings projecting into the peribranchial cavity, which may be compared with the polycarps of the genus *Polycarpa* amongst Simple Ascidians. Some of the polycarps are much more convex than others (compare figs. 8 and 9 on Pl. XLIV.).

The ova are few in number, and are generally placed near the centre of the polycarp (Pl. XLIV. fig. 8, *o*). The oviduct is a very wide slit, which usually appears curved in a crescentic manner in sections (Pl. XLIV. fig. 8, *o.d.*).

The spermatic vesicles are numerous, and are placed on all sides of the ovary (Pl. XLIV. fig. 8). They are pyriform vesicles (Pl. XLIV. fig. 10, *t.v.*) with delicate ducts, which join in twos and threes to form larger tubes which finally unite into one

duct on each side of the polycarp (Pl. XLIV. figs. 8, 9). The two ducts eventually unite into a single vas deferens which terminates on a prominent papilla projecting from the surface of the polycarp into the peribranchial cavity (Pl. XLIV. fig. 4, *v.d.*). The walls of the spermatic vesicles and their ducts are formed of distinct cubical epithelium, while the interior is occupied by small rounded cells and spermatozoa (Pl. XLIV. fig. 10, *t.v.*).

Figure 8 on Plate XLIV. represents a transverse section through a polycarp, showing the spermatic vesicles arranged symmetrically on the two sides of the ova and oviduct, while figure 4 represents a longitudinal section on one side of the middle line, showing the male system only. Figure 9 is an oblique section, and exhibits spermatic vesicles and their ducts cut at all angles. This last figure shows the position of the polycarp relatively to the superjacent mantle (*m.*) and test (*t.*).

A large number of tailed larvæ and some embryos were found in the peribranchial cavities of the Ascidiozooids. They lie mainly on the right side of the peribranchial cavity, and near the ventral edge. The fully formed tailed larva has an arrow-shaped body with a blunt anterior end (Pl. XLIII. fig. 9), and measures about 1 mm. in length, The tail is about 2·5 mm. in length and has a wide membranous fringe.

Goodsiria placenta, var. *fusca*, nov. (Pl. XLIV. figs. 5–7).

Two large colonies, dredged in Simon's Bay, Cape of Good Hope, from a depth of 10 to 20 fathoms, resemble *Goodsiria placenta* in general appearance, but differ in a number of details. Consequently I have thought it best to regard them as forming a variety of that species until further observations have been made upon the range of variability in the group, and upon the colours of the colonies in the living condition.

Both specimens are larger than the colonies of *Goodsiria placenta*, and although of the same general shape as that species, differ slightly in their proportions, being elongated transversely, so as to be more ovate than discoid (Pl. XLIV. fig. 5). They are also rather thinner, and their surfaces are flatter. The dimensions of the colonies are as follows:—

	A.	B.
Length,	9·0 cm.	8·0 cm.
Breadth,	12·0 „	11·5 „
Length of peduncle,	...	2·5 „

The colour of these specimens is very decidedly darker than in *Goodsiria placenta*, and the Ascidiozooids seen externally seem to be rather smaller and more numerous (see Pl. XLIV. fig. 5, and Pl. XLIII. fig. 1). The peduncle is relatively rather shorter; in one of the colonies it is absent.

The test is very much the same as that of *Goodsiria placenta*, but the mantle differs considerably in appearance and structure. It is thicker and more opaque than the

mantle of *Goodsiria placenta*, and the muscle bands are rather stronger and more regularly arranged (Pl. XLIV. fig. 7, *m.*). Most of them run longitudinally and transversely. The mantle is considerably pigmented; large patches of opaque white pigment corpuscles occurring every here and there.

The branchial sac is large and thin-walled, but differs from that of *Goodsiria placenta* in having the folds slight and the stigmata very small. There are three folds on each side of the sac, but they are very irregularly developed, being sometimes of fair size (Pl. XLIV. fig. 6, *br.f.*), while at other times they are quite rudimentary, and are represented merely by areas where a few of the internal longitudinal bars are unusually closely placed (Pl. XLIV. fig. 6, *br.f'.*). This condition recalls what is seen in *Styela grossularia* and some other members of the Styelinæ amongst Simple Ascidians. There may be from six to two internal longitudinal bars on a fold. There are usually three or four internal longitudinal bars in each interspace, in place of two as in *Goodsiria placenta*. Horizontal membranes are either absent or very slightly developed on the wide and irregular transverse vessels. The stigmata are numerous but very small (Pl. XLIV. fig. 6, *sg.*). They are rather irregularly arranged, the rows being frequently inclined, and occasionally splitting up into two rows or uniting again as new transverse vessels form or as two neighbouring vessels join (see Pl. XLIV. fig. 6). The ciliated cells are rather small, and their free ends do not project. There are a few muscle fibres developed in the vessels of the branchial sac, chiefly in the transverse vessels.

The endostyle is large and conspicuous. Its course is straight. The dorsal lamina has a plain edge, and the ribs are not so distinctly marked as in *Goodsiria placenta*.

The alimentary canal is fairly large. The œsophagus is short but wide; it curves posteriorly and then ventrally to enter the stomach. The stomach is nearly globular in shape. It is directed dorso-ventrally. Its wall is thick and is thrown into a large number of longitudinal folds. There are usually about twenty well-marked folds; they are strongly developed about the middle of the stomach and die away towards the œsophageal and intestinal ends. The intestine leaves the ventral end of the stomach, and almost at once turns anteriorly and then dorsally. It curves round the anterior edge of the stomach, forming rather a narrow loop, and then, opposite the œsophagus, it turns sharply forwards to become the rectum, which runs anteriorly for a short distance along the dorsal edge of the branchial sac. The intestine is rather wider than that of *Goodsiria placenta*, and the typhlosole in its interior is thrown into a series of convolutions which are visible through the comparatively thin walls of the intestine. The rectum is narrower than any other part of the alimentary canal. The system of branched tubules with dilated terminal bulbs is exceedingly well developed all over the walls of the intestine, and it communicates with the anterior edge of the stomach by the usual duct and vesicle. The vesicle on the wall of the stomach where the duct opens is apparently not so well developed as in *Goodsiria placenta*.

The reproductive organs form large masses attached to the inner surface of the mantle and projecting into the peribranchial cavity. These polycarps are larger than those of *Goodsiria placenta*, but are similar in other respects.

Several very large tailed larvæ were found in the peribranchial cavity of one of the Ascidiozooids examined.

The examination of further specimens of this form may possibly show that it ought to be regarded as a distinct species from *Goodsiria placenta*, but I am inclined to expect that intermediate forms will be found showing that both are members of a single variable species.

Goodsiria pedunculata, n. sp. (Pl. XLIV. figs. 1–3).

The Colony has the form of a rounded or pyriform mass supported on a peduncle. The upper end is wide and convex. The surface is uneven and not smooth. The colour is light grey.

The length is 4·5 cm., the breadth is nearly 3 cm., and the thickness is about 2·5 cm.

The Ascidiozooids are large and fairly numerous. They are distributed evenly over the surface of the colony. Their anterior ends show as rounded or elliptical areas of a slightly darker colour, usually from 2 mm. to 3 mm. in length. Each is provided with two apertures, which are prominent and conspicuous. The bodies of the Ascidiozooids are slightly elongated antero-posteriorly, but are not divided into regions.

The Test is firm and cartilaginous, and the outer layer is rather tougher than the rest. The internal part is white in sections, and is rather opaque. The matrix is apparently structureless, but test cells are abundant. There are no bladder cells. The test cells are not large; they are mostly of rounded and fusiform shapes, and are generally pigmented, of a yellowish-brown colour. Vessels are not numerous in the test.

The Mantle is moderately strong, and the musculature is well developed. The muscle bands run in all directions.

The Branchial Sac is large and rather delicate. No folds are present, but the internal longitudinal bars are well developed. They are regularly arranged and have no papillæ. The transverse vessels are moderately wide, and are all of about the same size. The stigmata are elliptical in shape and are of fair size. They are arranged with great regularity. The meshes are slightly elongated transversely, and each contains three stigmata.

The Endostyle is large and conspicuous. Its course is straight.

The Dorsal Lamina is a plain membrane.

The Tentacles are numerous, and are all of the same size.

The Alimentary Canal lies alongside the branchial sac. The stomach is globular and has its wall folded. The intestine is rather narrow.

The Reproductive Organs are in the form of polycarps, which are, however, unisexual.

Locality.—Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms; bottom, sand and gravel.

I place in this species two somewhat dissimilar colonies which were obtained off the east coast of the Falkland Islands, at a depth of 5 to 10 fathoms. The colony from which the dimensions given above are taken is a pyriform mass with a short and narrow stalk (Pl. XLIV. fig. 1). The stalk has been cut, but it was probably not more than 1 or 2 cm. in length.

The second specimen is very different in external appearance. It consists of a small rounded head attached to an enormously large peduncle. The head has evidently been injured, it looks as if the greater part of one side had been torn off, and what is left of that side is decayed and irregular: it measures 2·3 cm. in length, 2·1 cm. in breadth, and 1·5 cm. in greatest thickness. The peduncle is uneven, corrugated, and rough on the surface, is partially incrusted with colonies of Polyzoa, and has a few small black sand grains imbedded in its lower part. It measures 7·5 cm. in length, and is about 2 cm. in thickness. Throughout this great length of peduncle there are no Ascidiozooids, and although the head is incomplete, still there is no reason to suppose that it was any larger, if as large, as that of the other colony.

In both specimens the heads contain a large number of Ascidiozooids. In the pyriform specimen the branchial and atrial apertures of the Ascidiozooids are prominent and very conspicuous, even more so than is shown in the figure (Pl. XLIV. fig. 1). With a Coddington lens, or under a low power of the microscope, the apertures are seen to be distinctly four-lobed.

The region immediately around the branchial and atrial apertures is of a dark grey colour, with a slight bluish tinge, and in some cases of a decided slate colour, while the rest of the surface is much lighter (Pl. XLIV. fig. 1), being of a slightly hyaline whitish-grey. In the other specimen the head is of much the same colour as that just described, while the peduncle is of a dull grey colour throughout its length.

In sections the test is much lighter. In some places it is almost white, and has a distinct hyaline tint. It is very tough and cartilaginous, and contains vessels which branch and terminate in dilatations usually filled with blood-corpuscles. In sections through the test of the lower part of the colony imbedded sand grains are also found. In the injured specimen the apertures are scarcely so prominent as in the other, and are both irregularly four-lobed.

The test cells are in most places numerous, but in some regions they are very abundant, especially around the bodies of the Ascidiozooids. There they are always of a fusiform shape, and are placed with their long axes parallel to the surface of the Ascidiozooid. The opacity of the test is doubtless due to the presence of the slightly pigmented test

cells, as the matrix is clear and structureless, and the vessels are not sufficiently abundant to make any difference.

The muscle bands in the mantle are chiefly longitudinal, but transverse and oblique bands are also present in abundance. The sphincters are well developed, and large numbers of fine longitudinal muscle bands radiate from the bases of the two siphons.

The branchial sac differs from that of *Goodsiria placenta* in having no folds. It also has the stigmata on the whole rather larger and more regular (see Pl. XLIV. fig. 2, *sg.*). They are rounder than and not so long as those of *Goodsiria coccinea*, so that in the condition of the branchial sac the present species occupies a position between those of *Goodsiria placenta* and *Goodsiria coccinea*. The horizontal membranes on the transverse vessels are slight (Pl. XLIV. fig. 2, *tr.*).

The tentacles are rather short and stout, and, unlike those of *Goodsiria placenta*, they are all of the same size.

The œsophagus is long and narrow. It runs posteriorly and ventrally. The globular stomach has well-marked longitudinal folds. A transverse section shows (Pl. XLIV. fig. 3) that there is one very thick fold (*ty.*) and twelve slighter ones (*fd.*). They all project in for a considerable distance so as to greatly reduce the lumen. They are covered with ciliated columnar epithelium (*ep.*) The outer part of the stomach wall at the bases of the folds contains a large number of blood-vessels (Pl. XLIV. fig. 3, *b.v.*). The intestine runs anteriorly from the stomach, and then turns dorsally in a wide loop, and then anteriorly again to form the short rectum. The whole of the intestinal tract is very narrow.

The reproductive organs are in the form of polycarps imbedded in the mantle and projecting into the peribranchial cavity. These are unisexual, as in the case of *Synstyela incrustans*, and only female ones were found. Endocarps are also present attached to the mantle.

Goodsiria coccinea, Cunningham (Pl. XLV. figs. 1–19).

Goodsiria coccinea, Cunningham, Trans. Linn. Soc. Lond., vol. xxvii. p. 489.

The Colony is massive, and may be of rounded form, or elongated. It is attached by the lower end, is not pedunculated, and has the upper end wide and rounded. The surface is generally rather uneven, but smooth. The colour (after preservation in alcohol) is a pale bluish-grey.[1]

The length is 5 cm., the breadth is 2 cm., the thickness is 1 cm.

The Ascidiozooids are fairly large and numerous. They are distributed evenly over the surface of the colony, and are distinctly visible externally. The anterior end forms an elliptical area, generally 2 or 3 mm. in length, and bearing the conspicuous

[1] When living, according to Prof. R. O. Cunningham, it is scarlet.

branchial and atrial apertures, which are irregularly four-lobed. The bodies of the Ascidiozooids are slightly elongated antero-posteriorly, are of ellipsoidal form, and are not divided into regions. A large vascular appendage is given off from the posterior end of each.

The Test is firm and cartilaginous. In sections it is of a clear hyaline grey, and is semi-transparent. The matrix is crowded with minute test cells, and is delicately fibrillated. There are no bladder cells. Vessels are abundant, and branch freely; they terminate in ovate swollen bulbs.

The Mantle is strong, and has a well-developed musculature. The muscle bands run in all directions. The branchial and atrial sphincters are strong.

The Branchial Sac is large and well developed. It is not folded, but the internal longitudinal bars are well developed; they have no papillæ. The transverse vessels are moderately wide, and are all of about the same size. In addition there are intermediate much smaller transverse vessels which cross the meshes but do not interrupt the stigmata. Delicate horizontal membranes are present on the transverse vessels. The stigmata are long and narrow, and are arranged with regularity. The meshes are slightly elongated transversely, and contain each about eight stigmata.

The Alimentary Canal is not large. It lies alongside the branchial sac. The stomach is small and globular. It is folded longitudinally.

The Reproductive Organs are in the form of polycarps, which are imbedded in the mantle.

Localities.—(*a*) Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F. (nearly twenty specimens). (*b*) Station 314, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom, sand; bottom-temperature, 46° F. (four specimens). (*c*) Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 12 fathoms; bottom, sand and gravel (one specimen).

Various specimens collected during the Challenger Expedition, in the neighbourhood of the Strait of Magellan and the Falkland Islands, seem to belong to the species found by Dr. Cunningham in the same localities during the cruise of the "Nassau" in 1866 to 1869, and briefly described in 1871.[1] Cunningham also refers to the species in his work on the Strait of Magellan, and he gives figures showing a colony in surface view and in section, and some of the Ascidiozooids slightly magnified.

I have examined the specimens collected by Cunningham, and now in the British Museum, and have no doubt that the Challenger specimens belong to the same species. As, however, Cunningham's brief description and figures do not give the essential generic and specific characters, beyond the external appearance of the colony, and therefore only

[1] Notes on Reptiles, &c., obtained during the voyage of H.M.S. "Nassau," *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 489.

serve to indicate the family to which the specimens belong, I have thought it necessary to give the above detailed description.

This species is a notable example of the little value that can be attached to the colour of specimens preserved in alcohol. All of the Challenger specimens are shades of a light slate blue, and those in the British Museum are of very much the same colour, but Cunningham states that the specimens when living were of a vivid scarlet hue, and I find in my notes that the late Sir Wyville Thomson had told me that the Challenger specimens were of the same colour.

The colonies may attain a large size. The dimensions given above are taken from a small specimen, and are only of value as an indication of the proportions of the colony. The smallest Challenger specimens (see Pl. XLV. fig. 2) measure only a few millimetres in length and breadth, while the largest colony is about 46 cm. in length, 3·5 cm. in breadth, and 1·5 cm. in thickness. Cunningham states that his specimens were more than 2 feet in length. Figure 1 on Plate XLV. represents the upper end of a large colony.

The form varies considerably. In the small specimens it is more or less rounded (Pl. XLV. fig. 2). In the larger ones it becomes elongated. The Ascidiozooids are fairly conspicuous on the surface. In some places only the apertures are visible (Pl. XLV. fig. 1). Sometimes these are prominent, at other times depressed. They are irregularly four-lobed when partially open, and cross-slit when closed (Pl. XLV. fig. 3).

A section through the colony shows that the Ascidiozooids occupy only the superficial layer (Pl. XLV. fig. 1); they vary in size from 1 mm. to 5 mm. Cunningham speaks of them as being very small, and 1 line long, but in his figures he represents them as being of different sizes, as they are in the Challenger specimens (Pl. XLV. fig. 1). The shape of the body of the Ascidiozooid is irregularly ovoid, with both apertures at the anterior end.

The test is massive, and is usually firm. In the specimens from Station 313 the test seems to be rather softer and more gelatinous than in those from Station 314 and Station 315; it is also more flexible and elastic; in other respects the specimens are the same.

The delicate fibres in the matrix run in all directions. The test cells are small, and are mostly of rounded form (Pl. XLV. fig. 4). The vessels are conspicuous; most of the larger ones are divided by a median septum which is double, so that three cavities are thus formed (see Pl. XLV. fig. 4). Besides the terminal bulbs, occasional ovate swellings occur upon the course of the vessels. A vessel covered by a layer of mantle leaves the posterior end of each Ascidiozooid close to the intestine (Pl. XLV. figs. 9, 12).

In the mantle the chief muscle bands run transversely and longitudinally, and form a rudely square-meshed network. Oblique bands are also present. There are a large number of blood sinuses in the mantle, which makes it rather opaque. The branchial and atrial sphincters are equally strong (Pl. XLV. fig. 3, *br.* and *at.*).

The internal longitudinal bars in the branchial sac are wide (Pl. XLV. figs. 7, 8, *i.l.*). The larger transverse vessels, which bound the rows of stigmata, are provided with delicate horizontal membranes, which are exactly like the alternate smaller transverse vessels which cross the meshes (Pl. XLV. fig. 7, *tr.* and *tr'.*).

The stigmata in the fully developed sac are long and narrow (Pl. XLV. fig. 7), and much larger than in the other species of the genus; but in the young sac they are shorter and more rounded, and closely resemble those of *Goodsiria placenta* and *Goodsiria pedunculata*. Figures 5 and 6 show the condition of the stigmata in the younger sacs, and figure 6 also shows, in the very young Ascidiozooid, an arrangement of the internal longitudinal bars which suggests the presence of three rudimentary folds. This interesting indication of a relationship to the branchial sac of *Goodsiria placenta* is totally lost as the Ascidiozooid grows older. The stigmata are very regular in the adult sac, and the ciliated cells are well marked (Pl. XLV. fig. 8).

The endostyle is well developed. Its course is straight. In a transverse section of the ventral part of the body (Pl. XLV. fig. 16) the structure and relations of the endostyle are well seen. Its ventral-most part is continuous with the mantle (*m.*), and so separates the right and left halves of the peribranchial cavity (Pl. XLV. fig. 16, *p.br.c.*). The cells on the floor of the endostyle bear very long cilia, which in a transverse section project as a large tuft (Pl. XLV. fig. 16, *en.*), while the sides bear shorter and less conspicuous cilia.

The œsophagus is short (Pl. XLV. fig. 17, *œ.*). It runs backwards and ventrally to open into the small globular stomach (*st.*). There are usually about six well-marked folds upon the right side of the stomach. A transverse section (Pl. XLV. fig. 18) shows in addition a single large fold, which projects far into the interior, nearly dividing it into two cavities. The intestine is wider than the œsophagus (Pl. XLV. fig. 17, *i.*). It runs ventrally for a short distance from the stomach, and then turns anteriorly and then dorsally in a wide loop, running parallel to the stomach and œsophagus till it reaches the dorsal edge of the body, where it again turns anteriorly to become the short rectum (Pl. XLV. fig. 17, *r.*). The anus (*a.*) has a reflected margin. The stomach is provided with a short cæcum projecting from its left hand side, and not visible in figure 17. It curves towards the intestine in a semicircle (Pl. XLV. fig. 19).

The polycarps are not very conspicuous, as they are deeply buried in the mantle (Pl. XLV. fig. 13). When dissected out they are seen to be ovoid or flask-shaped bodies (Pl. XLV. fig. 14), with short projecting ducts. They are hermaphrodite, the same polycarp containing both ova and spermatic vesicles (Pl. XLV. fig. 13, *o.* and *t.v.*). The oviduct and vas deferens are occasionally seen cut in sections in the form of small tubes, the former slit-like and the latter circular in section (Pl. XLV. fig. 13, *o.d.* and *v.d.*). A few endocarps are also present projecting from the mantle into the peribranchial cavity. They are of the usual irregular shapes, with corrugated outlines (Pl. XLV. fig. 15).

Although I have not found any buds in the colonies examined, I am inclined to think

that gemmation takes place in connection with the vascular prolongations from the bodies of the Ascidiozooids into the test. A well-marked vessel, enclosed in a prolongation of the mantle, leaves the posterior end of each Ascidiozooid (Pl. XLV. figs. 9, 12) and runs for a longer or shorter distance through the test before ending in a dilated bulb (Pl. XLV. fig. 9, *t.k.*). Usually the vessels branch considerably (Pl. XLV. fig. 4, *v.*). Figure 9 shows an unusually simple condition.

Figure 10 on Plate XLV. represents a transverse section through the terminal bulb of a vessel with its covering of mantle, and figure 11 shows a part of a similar section more highly magnified, exhibiting spaces in the connective tissue of the mantle under the columnar layer of ectoderm cells. The three layers seen in this section (Pl. XLV. fig. 11, *ec.*, *mes.*, and *end.*) are probably continuous with the ectoderm, the mesoderm, and the endoderm respectively of the body of the parent Ascidiozooid.

Bearing in mind the part which similar vascular appendages play in the process of gemmation in other Compound Ascidians, the probability is that here also the young Ascidiozooids are developed in connection with these enlarged terminal bulbs on the vessels. Cunningham speaks of *Goodsiria* as a "Social Ascidian," thereby expressing, I suppose, his belief that gemmation takes place by means of vascular stolons as in the case of the Clavelinidæ.

Synstyela, Giard.

Synstyela, Giard, Assoc. franç. pour l'avancem. d. Sci., t. iii. Lille, 1874.

Colony thin and incrusting.

Ascidiozooids large and closely placed, completely imbedded in the common test. Body not divided into thorax and abdomen.

Test relatively small in amount. Matrix sometimes fibrillated; test cells small; bladder-cells absent; vessels present.

Branchial Sac well developed. Rudimentary folds present. Internal longitudinal bars well marked.

Dorsal Lamina in the form of a plain membrane.

Tentacles well developed.

Alimentary Canal not prolonged behind the branchial sac. Stomach folded longitudinally.

Reproductive Organs in the form of polycarps attached to the mantle.

This genus is one of the two forms very briefly described by Giard in 1874,[1] the other one being *Polystyela*. It differs from *Polystyela* and *Thylacium* in having the Ascidiozooids depressed and not projecting above the general surface of the colony. From *Goodsiria* and *Oculinaria* it differs in forming thin incrusting colonies, while the

[1] *Assoc. franç.*, Lille, t. iii.

continuity of the layer distinguishes it from *Chorizocormus*. Alder's *Thylacium variegatum*, on account of its depressed Ascidiozooids, probably belongs to this genus. It is doubtful whether that species is distinct from Giard's species of *Synstyela*. The new Challenger species described below seems to agree well with what is known of this genus, but, as Giard does not give a detailed description, it is possible that his species may be generically distinct, and in that case *Synstyela incrustans* must become the type of a new genus.

As Giard has given neither a formal diagnosis of *Synstyela* nor the materials for forming one, I have drawn up the above generic description from the new species collected during the Challenger Expedition. Alder's description of his *Thylacium variegatum* agrees with the characters I have given, and there is nothing in Giard's few remarks contrary to them, consequently I believe they will prove satisfactory.

The new species *Synstyela incrustans* is almost certainly distinct from those previously described, but, from our imperfect knowledge of Giard's species, it is impossible to give here a tabular representation of the genus. *Synstyela* has a very wide distribution in space. It has been found on the coast of France, in the British Seas, in the Strait of Magellan, and off the Philippine Islands.

Synstyela incrustans, n. sp. (Pl. XLVI. figs. 9–14).

The Colony forms a flat expansion of irregular form, attached by more or less of the lower surface. It is frequently lobed. The upper surface is uneven but smooth. The colour is light grey, with a bluish or pink tint in some places.

The length is 4 cm., the breadth is 2·5 cm., and the thickness is 7 mm.

The Ascidiozooids are large and numerous. They are closely placed, and form slight rounded projections on the surface of the colony. The usual size of the anterior end is 4 mm. or 5 mm. The bodies are not elongated antero-posteriorly, and are not divided into regions. The branchial and atrial apertures are conspicuous, but they are not distinctly lobed.

The Test is firm and tough, but is not massive. The upper surface is stronger and more opaque than the internal part, which is hyaline and semi-transparent in most places. The matrix is delicately fibrillated in some regions. It contains small rounded test cells, but they are not numerous. There are no bladder cells. Vessels are present in the test, but they are not conspicuous. They are very abundant on the spreading edges of the colony, where they terminate in elongated swollen bulbs.

The Mantle is thin and delicate. Its musculature is feebly developed.

The Branchial Sac is large and well developed. It has rudimentary folds. The internal longitudinal bars are numerous and strong. The ordinary transverse vessels are usually wide and all of the same size, but there are also two or three intermediate much

smaller transverse vessels crossing each mesh but not interrupting the stigmata. The meshes are square, and contain each about six long narrow stigmata.

The Dorsal Lamina is a plain narrow membrane.

The Tentacles are of two sizes, placed alternately; they are numerous, and the larger ones are of considerable size.

The Dorsal Tubercle is small, and has an inconspicuous rounded aperture placed close to the anterior end of the dorsal lamina.

The Alimentary Canal is moderately large. It forms a narrow loop. The stomach is large and has well-marked longitudinal folds.

The Reproductive Organs are in the form of polycarps, which project from the inner surface of the mantle. They are unisexual, and the male and female polycarps differ in form. Endocarps are also present.

Localities.—(*a*) Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F. (*b*) Samboangan, in the Philippine Islands; depth, 10 fathoms.

A considerable number of specimens of this species were obtained off Cape Virgins, at the extremity of the Strait of Magellan, from a depth of 55 fathoms, and one small colony, which seems not to be distinguishable specifically from the others, was obtained off Samboangan, in the Philippine Islands, at a depth of 10 fathoms.

Most of the specimens from the Strait of Magellan are attached to large individuals of *Molgula gigantea*, and form incrusting layers over the upper part of the test. The edges of the colony are in some places very thin spreading membranes composed of test only, while in other places they form free projecting lobes and contain Ascidiozooids. A few of the colonies are not incrusting, but project upwards from a small area of attachment in the form of more or less lobed flattened expansions (Pl. XLVI. fig. 9).

The dimensions given above are those of a small colony. Some of the incrusting specimens attain a much larger size (upwards of 20 cm. in length). The thickness varies somewhat. The colour is always greyish, but in some cases it is a slaty blue-grey, while in others it has a distinctly pink tint. The anterior ends of the Ascidiozooids are very conspicuous on the surface. In some colonies they occupy the entire surface of the colony, being merely separated by lines (Pl. XLVI. fig. 9), but in others a small amount of investing mass of a distinctly lighter colour may be seen between the Ascidiozooids. The branchial and atrial apertures are obscurely four-lobed. They generally appear circular until carefully examined.

The Ascidiozooids are flattened antero-posteriorly, a very rare condition amongst Compound Ascidians. They vary in size from 1 mm. to 8 mm. in greatest diameter. The smaller ones are mostly placed in the thin spreading margins of the colony, but they occasionally occur between larger Ascidiozooids in the centre of the mass.

The test is small in amount in this species, being reduced to thin membranes and narrow bars separating and surrounding the bodies of the Ascidiozooids. The upper layer forms a membrane, which is distinctly tougher than the part below. The test cells are few in number and of small size, and throughout the greater part of the test the vessels are few and inconspicuous. On the thin expanded margins, however, they become more numerous, and are usually found filled with blood-corpuscles. The long ovate bulbs on the terminal twigs are well marked. They resemble those found in a similar position in some species of *Botryllus*.

The muscle bands in the mantle run transversely and longitudinally (Pl. XLVI. fig. 12), but they are delicate.

The branchial sac is very like that of some Styelinæ amongst Simple Ascidians. The narrow transverse vessels crossing the meshes are well marked and are normally three in number (Pl. XLVI. fig. 10, *tr'.*), but in many of the meshes one and sometimes two of them are absent. The meshes are usually square and of large size, but along certain tracts, especially on each side of the dorsal lamina, three or four of the internal longitudinal bars become more closely placed (see Pl. XLVI. fig. 10) so as to form rudimentary folds, such as are seen in the branchial sac of *Styela grossularia* and some allied forms. The larger transverse vessels are variable in calibre (Pl. XLVI. fig. 10, *tr.*). In some sacs they are much narrower than is shown in the figure. The internal longitudinal bars of the branchial sac are rather wide (Pl. XLVI. fig. 10, *i.l.*). A single row of very large meshes, containing each about twelve stigmata, lies between the dorsal lamina and the rudimentary fold. Both the endostyle and the dorsal lamina are narrow.

The stomach is pyriform and of considerable size. About eight longitudinal folds are visible upon its side. It tapers gradually into the intestine, which turns anteriorly and then dorsally and runs alongside the anterior edge of the stomach so as to form a very narrow intestinal loop. The shape and course of the alimentary canal resemble somewhat those of *Botrylloides tyreum*[1] (see Pl. II. fig. 7). The system of glandular tubules with dilated ends is well developed, and covers the greater part of the intestinal wall.

The polycarps are fairly numerous (Pl. XLVI. fig. 12); they are not imbedded in the mantle, but project freely into the peribranchial cavity in the form of ovate or pyriform bodies, with narrow bases or short stalks by which they are attached to the mantle, and long tubular projections upon which their ducts open (see Pl. XLVI. fig. 12). The male polycarps are usually smaller, and are more of an irregularly rounded form, with no visible projections, or only very short ones (Pl. XLVI. fig. 13). In the female polycarps the more mature ova occupy the upper part of the structure, while very young ova are found at the lower end, next to the stalk (Pl. XLVI. fig. 12). Female polycarps in various stages of development were noticed. They commence as one (Pl. XLVI. fig. 12, upper end) and then two or three young ova which are imbedded in the mantle,

[1] Named *Botrylloides purpureum* on plate.

and form a slight projection towards the peribranchial cavity (Pl. XLVI. fig. 12). As the number of ova and their size increases the projection becomes larger and the ova pass completely into it, thus forming a young polycarp, attached to the mantle by its base. Endocarps are also present on the inner surface of the mantle. They have the usual irregular form and soft grey appearance (Pl. XLVI. fig. 14, *en.c.*).

Tailed larvæ of large size are present in abundance in the peribranchial cavities of some of the Ascidiozooids. They have short ovate bodies and very large tails (Pl. XLVI. fig. 11). Adhering papillæ are present at the anterior end of the body, and the single pigmented sense-organ is situated nearer to the anterior than to the posterior end. The tail is provided with a wide membranous margin (Pl. XLVI. fig. 11), which is supported by transversely running rays or fibres exactly like those described by Giard [1] as being present in the larva of his *Polystyela lemirri*.

In external appearance this species shows a certain resemblance to aggregations of *Styela grossularia* and some other allied Simple Ascidians such as are formed where individuals are closely crowded together and become attached to their neighbours' tests. The presence, however, of the thin spreading test margin at the edges of the colony, and of the numerous vessels with their dilated bulbs, shows that this is a colony and not merely an aggregation of individuals. The manner in which the young Ascidiozooids are imbedded in the test is also very different from the condition found in *Styela grossularia*, where, when aggregations take place, the young Ascidiozooids are merely slightly attached to the surface of the test of the older individuals, and only become firmly and closely united with them as they grow older and the test increases in amount.

The specimen from Samboangan may possibly prove, when more specimens are examined, to be a distinct variety. It is a small colony incrusting a fragment of an Alga, and is rather darker in colour than the specimens from the Strait of Magellan, and the Ascidiozooids seem to be of smaller size. The only difference I have detected in the internal structure is in the branchial sac, where, in the Samboangan specimen, there are no delicate transverse vessels crossing the meshes.

Chorizocormus,[2] n. gen.

Colony consisting of a number of distinct masses of small size united by irregular branched stolons.

Ascidiozooids placed either singly or in small groups in the test. When more than one is present they do not project above the general level. The body is not divided into thorax and abdomen.

Test relatively small in amount, slightly incrusted with sand. Test cells few, and bladder cells absent. Vessels present in the test and stolons.

[1] *Assoc. franç.*, t. iii., 1874.

[2] χωρίζω and κορμός.

Branchial Sac well developed. Rudimentary folds present. Internal longitudinal bars strong.
Dorsal Lamina in the form of a plain narrow membrane.
Tentacles well developed.
Alimentary Canal not prolonged behind the branchial sac.
Reproductive Organs in the form of polycarps.

This genus is founded for a remarkable species, several colonies of which were found at Kerguelen Island. It differs from all the other Polystyelidæ in producing colonies which are not continuous masses or layers of test in which the Ascidiozooids are imbedded, but consist of small rounded masses joined irregularly by creeping and sometimes branched stolons. This condition suggests at first a similarity to the Clavelinidæ amongst Ascidiæ Simplices, but the structure of the Ascidiozooids shows that if the genus is allied to Simple Ascidians it is not through the Clavelinidæ but rather through *Polycarpa* in the Cynthiidæ. The stolons, like those of the Clavelinidæ, consist of test penetrated by vascular prolongations from the Ascidiozooids, but that similarity does not, I believe, indicate any close or direct relationship.

In the table given on p. 326 I have placed the present genus in the section of the family where the Ascidiozooids are completely imbedded in the common test, but occasionally single Ascidiozooids are found isolated, being only connected with the rest of the colony by narrow stolons, and in such cases they project considerably above the surface. But wherever several Ascidiozooids are placed together in a mass they are completely imbedded and do not project. If *Chorizocormus* had been placed in the first section in the table, then it would have been readily separated from *Thylacium* by its Ascidiozooids having no abdomen, and from *Polystyela* by the remarkable shape of the colony. The characters will be discussed further under the description of the single known species of the genus.

This form is a valuable link between the other Polystyelidæ on the one hand and the Cynthiidæ amongst Simple Ascidians on the other (see Summary and General Remarks at the end of this Report).

Chorizocormus reticulatus, n. sp. (Pl. XLVI. figs. 1–8).

The Colony has the form of a number of more or less rounded masses of small size united by irregular creeping stolons, which may branch to form a rude network. The surface is moderately smooth, but is slightly incrusted with sand. The colour is light grey.

The size of the species varies greatly. The largest colony is about 15 cm. in length, and the smallest is less than 1 cm.

The Ascidiozooids are not large, and they are not very numerous. As a rule there is one Ascidiozooid in each of the rounded masses of the colony, but in some cases several Ascidiozooids are placed together in one mass; the apertures are in most cases placed upon slight papillæ projecting from one end of the Ascidiozooid; they are both four-lobed. The body of the Ascidiozooid is not elongated, and is not divided into regions.

The Test is thin, and tough and leathery, but not stiff. It is quite opaque. The matrix is minutely fibrillated in places. There are a few small rounded test cells, but no bladder cells are present. Vessels are found ramifying through the test. They are rather narrow, and do not branch much; the terminal twigs end in small rounded knobs. The stolons are penetrated by vessels.

The Mantle is strong, and has a well-developed musculature. The branchial and atrial sphincters are powerful.

The Branchial Sac is large and well-developed. Rudimentary folds are present, and the internal longitudinal bars are strong and conspicuous. The transverse vessels are moderately wide, and have slight horizontal membranes. The meshes are slightly elongated transversely, and contain each six or seven stigmata. They are divided by delicate transverse vessels which do not interrupt the long narrow stigmata.

The Dorsal Lamina is a plain narrow membrane with no ribs and no marginal teeth.

The Tentacles are rather short and stout. There are about twenty-four of them, and they are of two sizes placed alternately.

The Dorsal Tubercle is very large. It is elongated antero-posteriorly, and extends from the base of the tentacles to the dorsal lamina. The aperture is a long narrow slit.

The Alimentary Canal lies alongside the posterior part of the branchial sac. It is not large. The stomach has no well-marked folds.

The Reproductive Organs are in the form of polycarps, which are attached to the mantle. They are of small size, and are unisexual.

Locality.—Station 149D, January 20, 1874; Royal Sound, Kerguelen Island; lat. 49° 28′ S., long. 70° 13′ E.; depth, 28 fathoms; bottom, volcanic mud.

Station 149E, January 21, 1874; Greenland Harbour, Kerguelen; lat. 49° 37′ S., long. 70° 16′ E.; depth, 30 fathoms; bottom, volcanic mud.

Two large and several small colonies of this interesting species were obtained with the dredge from a depth of 30 fathoms in Royal Sound, Kerguelen Island.

Many of the Ascidiozooids are almost completely independent of one another (Pl. XLVI. fig. 2), being merely united by basal creeping stolons as in the case of the Clavelinidæ, but in other parts of the colony two or more Ascidiozooids may be found imbedded in the same mass of test (Pl. XLVI. fig. 3) as in the case of other Compound Ascidians. This species is therefore on the border line between the two groups, and

if it was an isolated form it would be extremely difficult if not impossible to determine whether it should be regarded as a Simple or a Compound Ascidian. It is, however, so closely allied to *Synstyela incrustans* and other members of the family Polystyelidæ, that it becomes an easier matter to trace its connection with true Compound Ascidians than with true Simple Ascidians, and therefore I have placed it in its present position amongst the Polystyelidæ. Its affinities will be further discussed in the General Summary at the end of the Report.

The masses of test containing several Ascidiozooids are each of various forms (see Pl. XLVI. figs. 1–4), and are connected with one another by narrow bands of test. The larger colonies (Pl. XLVI. fig. 1) consist of a very large number of these masses united by their stolons to form a very irregular mass clinging closely to some foreign body. The smaller colonies consist of several of the little masses, or of a few independent Ascidiozooids joined by the usual stolons (Pl. XLVI. figs. 2, 3, 4). As may be seen from figures 2 and 3, the masses differ considerably in their size. The average size is 2 or 3 mm. in diameter. The side branches given off from the stolons are frequently thickened at their ends so as to form small knobs (Pl. XLVI. figs. 1–4). The whole of the outer surface of the colony is slightly incrusted with fine black sand grains, otherwise it is of a dull but light grey, and fairly smooth.

The Ascidiozooids vary in size from about 1 mm. up to 8 mm. antero-posteriorly. The larger ones are generally independent of their neighbours, and have a striking resemblance to individuals of some of the smaller species of *Styela* and *Polycarpa*. The apertures in these large Ascidiozooids are placed on long tapering siphons. They are square when open and cross-slit when closed.

The test is relatively small in amount in this species. Where it covers the body of an Ascidiozooid it is a thin tough layer, slightly sandy on its outer surface, and perfectly smooth and glistening internally. The Ascidiozooid can readily be shelled out from its coating of test, as the mantle does not adhere to it very closely. The stolons are entirely formed by test. The vessels are not numerous, but they are present in all parts of the colony. One or more may always be found in the stolon running longitudinally, and occasionally giving off lateral branches which may be long or short (Pl. XLVI. fig. 5, *t. k.*). The terminal knobs are short and globular. The ectoderm cells on the surface of the vessels are very distinct (Pl. XLVI. fig. 5, *v.*).

The branchial and atrial sphincters are wide. They extend over nearly the whole of the elongated siphons. Both longitudinal and transverse muscle bands are found over the mantle generally; they form a close network (Pl. XLVI. fig. 8).

The branchial sac has a single rudimentary fold upon each side. It lies close to the dorsal lamina, and consists of four closely placed internal longitudinal bars. It is separated from the dorsal lamina by a single row of very wide meshes, each of which contains about a dozen stigmata. The transverse vessels and the internal longitudinal

bars are both well developed (Pl. XLVI. fig. 6, *tr.* and *i.l.*). The fine transverse vessels crossing the meshes (*tr'.*) are present with great regularity. The stigmata are long and narrow, like those of *Synstyela incrustans.*

The endostyle is conspicuous. Its course is straight. The tentacles are numerous, but none of them are very long. In the first specimen examined there were twelve long and about twelve smaller intermediate ones, while in the second specimen there were about sixteen larger and the same number of smaller tentacles. The smaller tentacles are frequently irregular in position and size (Pl. XLVI. fig. 7, *tn.*, *tn'.*); they are sometimes very minute.

The prebranchial zone lying between the tentacular circle and the peripharyngeal band is slightly papillated in places; it is rather narrow. The peripharyngeal band bends posteriorly at the dorsal edge to form a slight triangular peritubercular area (Pl. XLVI. fig. 7) which receives the posterior end of the large dorsal tubercle. In some cases this organ is not so exactly antero-posterior in direction as is shown in the figure (Pl. XLVI. fig. 7, *d.t.*), but is slightly inclined. The aperture is much elongated, and is not coiled at its ends. This dorsal tubercle is in a very different condition from that of *Synstyela incrustans*; it is frequently the case amongst Ascidians that closely allied species have very differently shaped dorsal tubercles.

The stomach is fairly large, but is thin-walled; the intestine is short. There are a large number of small polycarps projecting into the peribranchial cavity. They are of rounded or pyriform shapes (Pl. XLVI. fig. 8, *g.*), and are not deeply imbedded in the mantle; the ducts open upon small terminal papillæ. Most of those examined contained ova only (Pl. XLVI. fig. 8), but a few male ones were also found. No larvæ were discovered in the colony.

GEOGRAPHICAL DISTRIBUTION.

The introductory caution as to the insufficiency of our knowledge of the Geographical Distribution of Simple Ascidians which was given at the commencement of the corresponding section in the First Part of this Report applies with equal if not even greater force to the case of the Compound Ascidians. Still it may be of use to future investigators if the Challenger observations, so far as they have gone, are recorded and tabulated here; and the general arrangement and division into regions adopted in the First Part of the Report will be adhered to in order that a comparison of the results, in the case of the Simple and of the Compound Ascidians, may be readily made. In the map which will be found at the end of this Report the Geographical Distribution of the Simple as well as of the Compound Ascidians is indicated.

The track of the Challenger round the world has been divided into a series of comparatively short stages, so as to show roughly the localities between which the different observing Stations lie. These stages are arranged in the order in which they were traversed by the Expedition, and consequently the Stations are in chronological order, and the lists of species occur in the order in which they were collected. The chief objects of this arrangement are to show—(1) the approximate positions of the Stations at which Compound Ascidians were obtained, and (2) the list of species from each Station.[1]

The red circles on the map indicate the Stations at which Tunicata were obtained.

Between England and the Canary Islands no Compound Ascidians were obtained.

Between the Canary Islands and the West Indies no Compound Ascidians were obtained.

Between the West Indies and Halifax, Nova Scotia, the following Compound Ascidians were obtained:—

Off Bermuda; shallow water.

Botrylloides nigrum.
Symplegma viride.
Didemnum inerme.

[1] In the case of a few of the species the locality at which the specimens were obtained is not known. These species, of course, do not occur in the lists.

Station 48, May 8, 1873; lat. 43° 4′ N., long. 64° 5′ W.; depth, 51 fathoms; bottom, rock.

Aplidium despectum.

Between Halifax and Bermuda no Compound Ascidians were obtained.

Between Bermuda and the Canary Islands the following Compound Ascidian was obtained:—

Station 75, July 2, 1873; lat. 38° 38′ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

——— (?) *clava.*

Between the Canary Islands and Bahia, Brazil, the following Compound Ascidians were obtained:—

Off San Iago, Cape Verde Islands; depth, 10 to 125 fathoms.

Leptoclinum albidum.

Off Barra Grande; depth, 400 fathoms.

Cystodytes draschii.

Between Bahia and the Cape of Good Hope the following Compound Ascidians were obtained:—

Off Bahia; shallow water.

Aplidium crassum.
Leptoclinum speciosum.
Leptoclinum speciosum, var. *asperum.*
Leptoclinum annectens.
Diplosoma macdonaldi.

Between the Cape of Good Hope and Kerguelen Island the following Compound Ascidians were obtained:—

Simon's Bay, Cape of Good Hope; depth, 10 to 20 fathoms.

Atopogaster elongata, var. *pallida.*
Leptoclinum albidum.
Goodsiria placenta.
Goodsiria placenta, var. *fusca.*

Station 141, December 17, 1873; lat. 34° 41′ S., long. 18° 36′ E.; depth, 98 fathoms; bottom, green sand; bottom temperature, 49°·5.

Psammaplidium exiguum.

Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47°.

Amaroucium colelloides.
Psammaplidium subviride.
Leptoclinum edwardsi.

Off Marion Island; depth, 50 to 75 fathoms

Sidnyum pallidum.

Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom, Diatom ooze; bottom temperature, 34°·2.

Pharyngodictyon mirabile.

Between Kerguelen Island and Melbourne, Australia, the following Compound Ascidians were obtained:—

Station 149A, Betsy Cove, Kerguelen, January 14, 1874; lat. 49° 8′ S., long. 70° 9′ E.; depth, 40 fathoms; volcanic mud.

Colella quoyi.

Station 149C, Balfour Bay, Kerguelen Island, January 19, 1874; lat. 49° 32′ S., long. 70° 0′ E.; 20 to 60 fathoms; volcanic mud.

Colella pedunculata.
Morchellium giardi.
Polyclinum minutum.
Aplidium fuscum.
Amaroucium variabile.
Leptoclinum rubicundum.

Station 149D, Royal Sound, Kerguelen, January 20, 1874; lat. 49° 28′ S., long. 70° 13′ E.; 0 to 30 fathoms; volcanic mud.

———(?) *pyriformis.*
Aplidium fumigatum.
Amaroucium variabile.
,, ,, var. *tenerum.*
,, *nigrum.*
Leptoclinum subflavum.
Chorizocormus reticulatus.

Off Christmas Harbour, Kerguelen, January 29, 1874; depth, 50 to 120 fathoms.

Amaroucium complanatum.
Psammaplidium retiforme.

Kerguelen; 10 to 100 fathoms.

Colella pedunculata.
,, *concreta.*
Tylobranchion speciosum.
Morchellioides affinis.
Polyclinum pyriforme.
Aplidium leucophæum.
,, *fumigatum.*
Amaroucium variabile.
,, ,, var. *tenerum.*
,, *globosum.*

Station 151, February 7, 1874; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ E.; depth, 75 fathoms; volcanic mud.

Colella pedunculata.

Between Melbourne, Australia, and New Zealand the following Compound Ascidians were obtained:—

Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 to 40 fathoms; bottom, sand and shells.

Colella murrayi, var. *rubida.*
Atopogaster aurantiaca.[1]
Amaroucium albidum.[1]
Didemnum aurantiacum.

Station 163D, June 12, 1874; lat. 33° 57′ 30″ S., long. 151° 39′ 15″ E.; depth, 120 fathoms; green sand.

Colella murrayi.

Port Jackson, Sydney, Australia; depth, 7 to 30 fathoms.

Colella elongata.
Polyclinum fungosum.
Psammaplidium spongiforme.
Leptoclinum (?) *jacksoni.*

Between New Zealand and the Fiji Islands the following Compound Ascidian was obtained:—

Off Tongatabu, Friendly Islands.

Leptoclinum tonga.

[1] The label in the bottle gives 85 fathoms as the depth from which these species were obtained.

Between the Fiji Islands and Hong Kong, China, the following Compound Ascidians were obtained :—

Station 186, September 8, 1874; lat. 10° 30″S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud.

Psammaplidium pyriforme.

Station 187, September 9, 1874; lat. 10° 36′ S., long. 141° 55′ E.; depth, 6 fathoms; coral mud.

Colella pulchra.

Torres Strait; depth, 3 to 11 fathoms.

Polyclinum depressum.
Psammaplidium ovatum.

Off the Arrou Islands.

Diplosomoides molle.

Between Hong Kong and New Guinea the following Compound Ascidians were obtained :—

Station 208, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud.

Botrylloides tyreum.

Off Zebu, Philippine Islands; shallow water.

Aplidium fumigatum.

Station 209, January 22, 1875; lat. 10° 14′ N., long. 123° 54′ E.; depth, 95 fathoms; bottom, blue mud; bottom temperature, 71°.

Leptoclinum albidum, var. *grande.*

Samboangan, Philippine Islands; depth, 10 fathoms.

Cystodytes philippinensis.
Leptoclinum moseleyi.
Synstyela incrustans.

Station 212, January 30, 1875; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms; bottom, sand.

Botrylloides perspicuum.
„ „ var. *rubicundum.*
Colella thomsoni.
Distaplia vallii.

Between New Guinea and Japan the following Compound Ascidians were obtained:—

Station 233A, May 19, 1875; lat. 34° 38′ N., 135° 1′ E.; depth, 50 fathoms; sand.

Leptoclinum japonicum.

Between Japan and the Sandwich Islands no Compound Ascidians were obtained.

Between the Sandwich Islands and Valparaiso no Compound Ascidians were obtained.

Between Valparaiso and the Falkland Islands the following Compound Ascidians were obtained:—

Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ W.; depth, 175 fathoms; blue mud.

Leptoclinum tenue.

Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46°·0.

Colella ramulosa.
Amaroucium recumbens.
Leptoclinum tenue.
„ *propinquum.*

Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8.

Colella pedunculata.
Atopogaster gigantea.
„ *elongata.*
Polyclinum incertum
Amaroucium irregulare.
„ „ var. *concinnum.*
„ *lævigatum.*
———— (?) *ignotus.*
Goodsiria coccinea.
Synstyela incrustans.

Station 314, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom, sand; bottom temperature, 46°.

Goodsiria coccinea.

Between the Falkland Islands and Buenos Ayres, South America, the following Compound Ascidians were obtained:—

Station 315, January 26 to 28, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms; bottom, sand and gravel.

Colella pedunculata.
„ *gaimardi.*
Amaroucium pallidulum.
Goodsiria pedunculata.
„ *coccinea.*

Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2.

Polyclinum molle.
Aplidium incrustans.
Psammaplidium effrenatum.
„ *flavum.*
Leptoclinum tenue.

Between Buenos Ayres and England no Compound Ascidians were obtained.

The above lists have given information in regard to the bathymetrical as well as the geographical distribution of the species, but a better general notion of the latter alone may be obtained by grouping the Stations at which Compound Ascidians were collected into the series of geographical regions given below.[1] The object in this arrangement is to show the Compound Ascidian fauna of each of these regions, so far as it has been made known by the Challenger investigations.

In the North Atlantic (East) the following Compound Ascidians were obtained:—

At Station 75.
——— (?) *clava.*

Off Cape Verde Islands.
Leptoclinum albidum.

In the North Atlantic (West) the following Compound Ascidians were obtained:—

Off Bermuda.
Botrylloides nigrum.
Symplegma viride.
Didemnum inerme.

[1] In this case all details as to the exact position, depth, temperature, &c., of the Stations have been omitted, as these have already been given in full in the first list.

At Station 48.

Aplidium despectum.

Off the east coast of South America the following Compound Ascidians were obtained :—

Off Barra Grande.

Cystodytes draschii.

Off Bahia.

Aplidium crassum.
Leptoclinum speciosum.
,, ,, var. *asperum.*
,, *annectens.*
Diplosoma macdonaldi.

At the Cape of Good Hope and the neighbourhood the following Compound Ascidians were obtained :—

At Simon's Bay.

Atopogaster elongata, var. *pallida.*
Leptoclinum albidum.
Goodsiria placenta.
,, ,, var. *fusca.*

At Station 141.

Psammaplidium exiguum.

At Station 142.

Amaroucium colelloides.
Psammaplidium subviride.
Leptoclinum edwardsi.

In the Southern Ocean the following Compound Ascidians were obtained :—

Off Marion Island.

Sidnyum pallidum.

At Station 147.

Pharyngodictyon mirabile.

At Kerguelen Island.

Colella pedunculata.
„ *quoyi.*
„ *concreta.*
——— (?) *pyriformis.*
Tylobranchion speciosum.
Morchellioides affinis.
Morchellium giardi.
Polyclinum minutum.
„ *pyriforme.*
Aplidium fuscum.
„ *leucophœum.*
„ *fumigatum.*
Amaroucium variabile.
„ „ var. *tenerum.*
„ *globosum.*
„ *nigrum.*
„ *complanatum.*
Psammaplidium retiforme.
Leptoclinum rubicundum.
„ *subflavum.*
Chorizocormus reticulatus.

At Station 151.

Colella pedunculata.

On the south-east coast of Australia the following Compound Ascidians were obtained:—

At Station 162.

Colella murrayi, var. *rubida.*
Atopogaster aurantiaca.
Amaroucium albidum.
Didemnum aurantiacum.

At Station 163D.

Colella murrayi.

At Port Jackson.

Colella elongata.
Polyclinum fungosum.
Psammaplidium spongiforme.
Leptoclinum (?) *jacksoni.*

In the Southern Pacific Ocean the following Compound Ascidian was obtained :—

Off Tongatabu.

Leptoclinum tonga.

In the Seas of the Malay Archipelago the following Compound Ascidians were obtained :—

At Station 186.

Psammaplidium pyriforme.

At Station 187.

Colella pulchra.

In Torres Strait.

Polyclinum depressum.
Psammaplidium ovatum.

Off the Arrou Islands.

Diplosomoides molle.

At Station 208.

Botrylloides tyreum.

Off Zebu, Philippine Islands.

Aplidium fumigatum.

At Station 209.

Leptoclinum albidum, var. *grande.*

Off Samboangan, Philippine Islands.

Cystodytes philippinensis.
Leptoclinum moseleyi.
Synstyela incrustans.

At Station 212.

Botrylloides perspicuum.
„ „ var. *rubicundum.*
Colella thomsoni.
Distaplia vallii.

Off Japan the following Compound Ascidian was obtained :—

At Station 233A.

Leptoclinum japonicum.

Off the southern end of South America the following Compound Ascidians were obtained :—

At Station 308.

Leptoclinum tenue.

At Station 311.

Colella ramulosa.
Amaroucium recumbens.
Leptoclinum tenue.
„ *propinquum.*

At Station 313.

Colella pedunculata.
Atopogaster gigantea.
„ *elongata.*
Polyclinum incertum.
Amaroucium irregulare.
„ „ var. *concinnum.*
„ *lævigatum.*
——————— (?) *ignotus.*
Goodsiria coccinea.
Synstyela incrustans.

At Station 314.

Goodsiria coccinea.

At Station 315.

Colella pedunculata.
„ *gaimardi.*
Amaroucium pallidulum.
Goodsiria pedunculata.
„ *coccinea.*

At Station 320.

Polyclinum molle.
Aplidium incrustans.
Psammaplidium effrenatum.
„ *flavum.*
Leptoclinum tenue.

These lists seem to indicate that Compound Ascidians are very much more abundant at some localities (*e.g.*, Simon's Bay, Kerguelen Island, Station 162, Station 313) than at others; but it must be noted that in the case of Kerguelen Island the length of the list is due, to a certain extent, to the very considerable time (several weeks) spent by the Expedition in investigating that region. Some areas in the above list, however, in which there were a large number of observing Stations, show singularly few Compound Ascidians. For example, no specimens were obtained in the South Atlantic between Bahia and Simon's Bay (see the Map, where the red circles indicate the Stations at which Simple or Compound Ascidians were found), only a single species was obtained in the South Pacific Ocean, and none in the North Pacific. On the other hand, some of the more limited areas have long lists of species; for example, twenty-one species were found in the immediate neighbourhood of Kerguelen Island, nine species on the south-eastern coast of Australia, and fourteen species in the Strait of Magellan.

In the table given below, the geographical regions already made use of have been grouped together to form seven great areas,[1] namely:—

(1) The North Atlantic,
(2) The South Atlantic,
(3) The Southern Ocean (the region lying to the south of the Indian Ocean, and including Kerguelen Island),
(4) The seas of the Malay Archipelago (the area lying between Australia and China),
(5) The North Pacific,
(6) The South Pacific, and
(7) The shores of the southern end of South America from Valparaiso on the west coast to Monte Video on the east.

This last named area has been separated from the South Atlantic and the South Pacific Oceans, to which its eastern and its western parts should respectively belong, because of the large number of Compound Ascidians which were found on the Patagonian coasts, and the difficulty of dividing them naturally into an east coast and a west coast series.

As the species are arranged in systematic order, this table shows at a glance the distribution of any particular species, genus, or family in the great ocean basins, according to the Challenger investigations.

[1] Indicated by the red numbers 1 to 7 in the map at the end of the Report.

TABLE SHOWING THE DISTRIBUTION OF THE FAMILIES, GENERA, AND SPECIES OF ASCIDIÆ COMPOSITÆ[1] THROUGHOUT THE GREAT OCEAN BASINS.

SPECIES.	1. North Atlantic.	2. South Atlantic.	3. Southern Ocean.	4. Seas of Malay Archip.	5. North Pacific.	6. South Pacific.	7. Seas of South America.
Family BOTRYLLIDÆ.							
Botrylloides tyreum,				+			
perspicuum,				+			
var. *rubicundum*,				+			
nigrum,	+						
fulgurale,	+						
Sarcobotrylloides wyvillii,	+						
Polycyclus lamarcki,	+						
jeffreysi,	+						
Family DISTOMIDÆ.							
Colella pedunculata,			+				+
thomsoni,				+			
gaimardi,							+
pulchra,				+			
elongata,						+	
quoyi,			+				
murrayi,						+	
var. *rubida*,						+	
ramulosa,							+
concreta,			+				
Distaplia vallii,	+			+			
—— (?) *clava*,	+						
—— (?) *pyriformis*,			+				
Cystodytes draschii,		+					
philippinensis,				+			
Symplegma viride,	+						
Family POLYCLINIDÆ.							
Pharyngodictyon mirabile,			+				
Tylobranchion speciosum,			+				
Atopogaster gigantea,							+
aurantiaca,						+	
informis,							
elongata,							+
var. *pallida*,		+					
Morchellioides affinis,			+				
Morchellium giardi,			+				

[1] Those collected during the "Lightning," "Porcupine," and Challenger Expeditions.

Species.	1. North Atlantic.	2. South Atlantic.	3. Southern Ocean.	4. Seas of Malay Archip.	5. North Pacific.	6. South Pacific.	7. Seas of South America.
Sidnyum pallidum,			+				
Polyclinum pyriforme,			+				
fungosum,						+	
depressum,				+			
molle,		+					
incertum,							+
minutum,			+				
Aplidium incrustans,		+					
fuscum,			+				
leucophæum,			+				
crassum,		+					
fallax,	+						
despectum,	+						
fumigatum,			+	+			
Amaroucium variabile,			+				
var. *tenerum*,			+				
globosum,			+				
complanatum,			+				
irregulare,							+
var. *concinnum*,							+
pallidulum,							+
recumbens,							+
hepaticum,							
lævigatum,							+
colelloides,		+					
albidum,						+	
nigrum,							+
Psammaplidium spongiforme,						+	
effrenatum,							+
rude,							
subviride,		+					
exiguum,		+					
ovatum,				+			
retiforme,			+				
flavum,							+
pyriforme,				+			
——— (?) *ignotus*,							+
Family Didemnidæ.							
Didemnum savignii,			+				
aurantiacum,						+	
inerme,	+						
Leptoclinum tonga,						+	
moseleyi,				+			

Species.	1. North Atlantic.	2. South Atlantic.	3. Southern Ocean.	4. Seas of Malay Archip.	5. North Pacific.	6. South Pacific.	7. Seas of South America.
Leptoclinum speciosum,		+					
var. *asperum*,		+	+				
annectens,		+					
tenue,	+	+					+
var. *magnizooidium*,	+						
propinquum,							+
neglectum,			•				
albidum (?),	+	+					
var. *luteolum* (?),	+						
var. *grande*,				+			
subflavum,			+				
jeffreysi,	+						
carpenteri,	+						
thomsoni,	+						
edwardsi,		+					
japonicum,					+		
Leptoclinum (?) *jacksoni*,						+	
rubicundum,			+				
Family Diplosomidæ.							
Diplosomoides molle,				+			
Diplosoma macdonaldi,		+					
Family Cœlocormidæ.							
Cœlocormus huxleyi,							+
Family Polystyelidæ.							
Goodsiria placenta,		+					
var. *fusca*,		+					
pedunculata,							+
coccinea,							+
Synstyela incrustans,				+			+
Chorizocormus reticulatus,			+				
Total number of species or varieties which occurred in each of the seven areas	18	17	24	15	1	10	21

The preceding Table shows—first, that the Challenger Expedition obtained Compound Ascidians in all of the seven great areas into which the seas of the globe have been divided; and, secondly, that comparatively few species were found in the Pacific Oceans. This is somewhat surprising, since more species of Simple Ascidians were collected in the South Pacific area than in any of the other regions.[1]

The Botryllidæ appear to be almost entirely confined to the North Atlantic, the only exceptions—according to the Challenger investigations—being the two species and a variety of *Botrylloides* which were obtained at or near the Philippine Islands.

The Distomidæ are distributed throughout all the oceanic areas with the exception of the North Pacific, and the genus *Colella* is represented in at least four of them, the Southern Ocean, the seas of the Malay Archipelago, the South Pacific, and the seas of South America.

The great family Polyclinidæ is also found in all the regions except the North Pacific; more species are found in the Southern Ocean than elsewhere. Some of the larger genera, such as *Polyclinum*, *Aplidium*, *Amaroucium*, and *Psammaplidium*, have a very wide range.

The Didemnidæ occur in all the seven areas, the single Compound Ascidian (*Leptoclinum japonicum*) found in the North Pacific being a species of this family. The genus *Leptoclinum* (the largest genus in the Challenger Collection) is represented in all the regions, but is more abundant in the North and South Atlantic than elsewhere.

The Challenger Diplosomidæ occur in the South Atlantic and in the Malay region. The family was previously known from the North Atlantic area. The Cœlocormidæ are only known from the South American region.

The family Polystyelidæ has a wide range. It was previously known from the North Atlantic area, and the Challenger investigations have shown that it is also represented in the South Atlantic, the Southern Ocean, the Malay seas, and the South American region. No members of the family have yet been discovered in the Pacific Ocean.

Probably the most important conclusion to be drawn from the table is the wide distribution of most of the families and genera.

In the following table, the last illustrating the geographical distribution of the Ascidiæ Compositæ, the occurrence of the different genera and species according to the latitude is shown in both northern and southern hemispheres. A + means merely that the species opposite which it is placed was found by the Challenger Expedition somewhere between the limits of latitude which the column represents. Hence it may indicate more than one occurrence of the same species.

[1] See Part I. of this Report (vol. vi., 1882), p. 262.

North Latitude.					Species.	South Latitude.				
65°-40°[1]	40°–30°	30°–20°	20°–10°	10°–0°		0°–10°	10°–20°	20°–30°	30°–40°	40°–55°
			+		*Botrylloides tyreum*					
				+	*perspicuum*					
				+	v. *rubicundum*					
	+				*nigrum*					
+					*fulgurale*					
+					*Sarcobotrylloides wyrillii*					
+					*Polycyclus lamarcki*					
	+				*jeffreysi*					
					Colella pedunculata					+
				+	*thomsoni*					
					gaimardi					+
					pulchra		+			
					elongata				+	
					quoyi					+
					murrayi				+	
					var. *rubida*				+	
					ramulosa					+
					concreta					+
	+			+	*Distaplia vallii*					
	+				—— (?) *clava*					
					—— (?) *pyriformis*					+
					Cystodytes draschii	+				
				+	*philippinensis*					
	+				*Symplegma viride*					
					Pharyngodictyon mirabile					+
					Tylobranchion speciosum					+
					Atopogaster gigantea					+
					aurantiaca				+	
					informis					
					elongata					+
					var. *pallida*				+	
					Morchellioides affinis					+
					Morchellium giardi					+
					Sidnyum pallidum					+
					Polyclinum pyriforme					+
					fungosum				+	
					depressum		+			
					molle				+	
					incertum					+
					minutum					+
					Aplidium incrustans				+	
					fuscum					+
					leucophœum					+
					crassum		+			

[1] This column has been made 40°–65° in order that the species obtained during the "Lightning" and "Porcupine" expeditions might be included in the record.

North Latitude.					Species.	South Latitude.				
65°–40°	40°–30°	30°–20°	20°–10°	10°–0°		0°–10°	10°–20°	20°–30°	30°–40°	40°–55°
+					*Aplidium fallax*,					
+					*despectum*,					
			+		*fumigatum*,					+
					Amaroucium variabile,					+
					var. *tenerum*,					+
					globosum,					+
					complanatum,					+
					irregulare,					+
					v. *concinnum*,					+
					pallidulum,					+
					recumbens,					+
					hepaticum,					
					lævigatum,					+
					colelloides,				+	
					albidum,				+	
					nigrum,					+
					Psammaplidium spongiforme,				+	
					effrenatum,				+	
					rude,					
					subviride,				+	
					exiguum,				+	
					ovatum,		+			
					reticulatum,					+
					flavum,				+	
					pyriforme,		+			
					——————— (?) *ignotus*,					+
					Didemnum savignii,				+	
					aurantiacum,				+	
	+				*inerme*,					
					Leptoclinum tonga,			+		
				+	*moseleyi*,					
					speciosum,		+			
					var. *asperum*,		+		+	
					annectens,		+			
+					*tenue*,				+	+
+					v. *magnizooidium*,					
					propinquum,					+
					neglectum,					
			+		*albidum* (?),				+	
	+				var. *luteolum*,					
			+		var. *grande*,					
					subflavum,					+
	+				*jeffreysi*,					
+					*carpenteri*,					
+					*thomsoni*,					

North Latitude.					Species.	South Latitude.				
65°–40°	40°–30°	30°–20°	20°–10°	10°–0°		0°–10°	10°–20°	20°–30°	30°–40°	40°–55°
					Leptoclinum edwardsi				+	
	+				*japonicum*					
					jacksoni				+	
					rubicundum					+
					Diplosomoides molle	+				
					Diplosoma macdonaldi		+			
					Cœlocormus huxleyi				+	
					Goodsiria placenta				+	
					var. *fusca*				+	
					pedunculata					+
					coccinea					+
				+	*Synstyela incrustans*					+
					Chorizocormus reticulatus					+
9	9	0	4	7	Total number of entries in each column.	2	9	1	25	39
Northern hemisphere, 29.					Total number of entries in each hemisphere.	Southern hemisphere, 76.				

This table brings out very forcibly—first, the great preponderance of Compound Ascidians in the southern over the northern hemisphere, there being between two and three times as many entries on the right hand side of the table as on the left, notwithstanding the fact that more than one-third of those on the latter are due to species obtained during the cruises of the "Lightning" and "Porcupine," which were confined to the northern hemisphere; and secondly, the great abundance of Compound Ascidians in the far south, the two last columns in the right hand side (30°–40° and 40°–55°, 25° in all) containing together a good deal more than half the total number of entries. Consequently, it would appear from the Challenger investigations that the Compound Ascidians, like the Simple Ascidians, attain their greatest numerical development in the southern temperate zone.

The family Botryllidæ appears to be confined to the northern hemisphere, in which, however, it has a wide range.

The Distomidæ are well represented in both hemispheres, and they extend widely both to the north and to the south of the equator. The genus *Colella* is mainly a southern form, and is only represented north of the equator by *Colella thomsoni*, from the Philippine Islands.

The Polyclinidæ, according to the Challenger investigations, is almost entirely a southern family, as it is represented by about forty species in the southern hemisphere,

and by only three in the northern. More than half the new species in this family were obtained to the south of 40° south latitude.

In the Didemnidæ, on the other hand, there is no such disproportion; the northern hemisphere shows eleven entries and the southern fifteen, and the members of the family are apparently scattered widely. The genus *Leptoclinum* is well represented in both hemispheres, and has a wider range than any other genus in the collection. It is not a markedly southern form, and in this respect it contrasts with *Amaroucium*, the next largest genus, which has nearly all its species confined to the far south.

The Challenger Diplosomidæ are from tropical seas, and the family Cœlocormidæ is only known from the southern hemisphere.

The Polystyelidæ have a wide range. Most of the Challenger species are from far south, but one (*Synstyela incrustans*) also occurs north of the equator. The species of the family which were known previously are from the north temperate zone. These, however, belong to genera distinct from the southern forms

BATHYMETRICAL DISTRIBUTION.

In this section, as in the preceding one, the Challenger results will be treated in the same manner as that which was adopted in the First Part of this Report, in order that the conclusions arrived at in the case of the Compound Ascidians may be readily combined or compared with those given for the Simple Ascidians.[1]

The first table given below shows the range in depth of the species, genera, and families of Compound Ascidians. The names are arranged systematically, and only the extreme limits of depth at which each species has been found are given.

In the case of a few of the species the depths at which they were obtained is not known.

Family, Genus, and Species.	Range in Depth.
BOTRYLLIDÆ—	
Botrylloides tyreum,	18 fathoms.
perepicuum,	10 „
var. *rubicundum*,	10 „
nigrum,	Shallow water.
fulgurale,	530 fathoms.
Sarcobotrylloides wyvillii,	363 „
Polycyclus lamarcki,	363 „
jeffreysi,	35 „
DISTOMIDÆ—	
Colella pedunculata,	10–75 „
thomsoni,	10 „
gaimardi,	5–10 „
pulchra,	6 „
elongata,	30 „
quoyi,	25 „
murrayi,	120 „
var. *rubida*,	38 „
ramulosa,	245 „
concreta,	10–60 „
Distaplia vallii,	10–35 „

[1] See Part I. of this Report (vol. vi., 1882), p. 267.

Family, Genus, and Species.	Range in Depth.
——— (?) *clava*,	450 fathoms.
——— (?) *pyriformis*,	Shallow.
Cystodytes draschii,	400 fathoms.
philippinensis,	10 „
Symplegma viride,	Shallow water.
POLYCLINIDÆ—	
Pharyngodictyon mirabile,	1600 fathoms.
Tylobranchion speciosum,	10–100 „
Atopogaster gigantea,	55 „
aurantiaca,	(?) 85 „
informis,	.....
elongata,	55 „
var. *pallida*,	10–20 „
Morchellioides affinis,	10–60 „
Morchellium giardi,	20–60 „
Sidnyum pallidum,	50–75 „
Polyclinum pyriforme,	10–60 „
fungosum,	6–15 „
depressum,	3–11 „
molle,	600 „
incertum,	55 „
minutum,	20–60 „
Aplidium incrustans,	600 „
fuscum,	20–60 „
leucophæum,	10–60 „
crassum,	Shallow water.
fallax,	10 fathoms.
despectum,	51 „
fumigatum,	10–100 „
Amaroucium variabile,	10–100 „
var. *tenerum*,	10–60 „
globosum,	10–60 „
complanatum,	50–120 „
irregulare,	55 „
var. *concinnum*,	55 „
pallidulum,	12 „
recumbens,	245 „
hepaticum,	.....
lævigatum,	55 „
colelloides,	150 „
albidum,	38 „
nigrum,	28 „
Psammaplidium spongiforme,	7 „
effrenatum,	600 „
rude,	.....

Family, Genus, and Species.	Range in Depth.
Psammaplidium subviride,	150 fathoms.
exiguum,	98 „
ovatum,	3–11 „
retiforme,	50–120 „
flavum,	600 „
pyriforme,	8 „
——— (?) *ignotus*,	55 „
DIDEMNIDÆ—	
Didemnum savignii,	150 „
aurantiacum,	38 „
inerme,	Shallow water.
Leptoclinum tonga,	18 fathoms.
moseleyi,	10 „
speciosum,	7–20 „
var. *asperum*,	7–20 „
annectens,	Shallow water.
tenue,	175–600 fathoms.
var. *magnizooidium*,	.....
propinquum,	245 „
neglectum,	.....
albidum (?),	10–125 „
var. *luteolum* (?),	35 „
var. *grande*,	95 „
subflavum,	28 „
jeffreysi,	35 „
carpenteri,	.....
thomsoni,	.....
edwardsi,	150 „
japonicum,	50 „
(?) *jacksoni*,	6–15 „
rubicundum,	20–60 „
DIPLOSOMIDÆ—	
Diplosomoides molle,	Shallow water.
Diplosoma macdonaldi,	Shallow water.
CŒLOCORMIDÆ—	
Cœlocormus huxleyi,	600 fathoms.
POLYSTYELIDÆ—	
Goodsiria placenta,	10–20 „
var. *fusca*,	10–20 „
pedunculata,	5–10 „
coccinea,	5–70 „
Synstyela incrustans,	10–55 „
Chorizocormus reticulatus,	30 „

From this table it is a simple matter to determine the range in depth of any particular genus, *e.g.*:—

Botrylloides	.	extends from shallow water to 530 fathoms.
Colella	.	„ 5 to 245 fathoms.
Polyclinum	.	„ 3 to 600 „

The seven families of Ascidiæ Compositæ are found to have the following limits:—

The Botryllidæ range from the shore to 530 fathoms.
The Distomidæ „ „ 450 „
The Polyclinidæ „ „ 1600 „
The Didemnidæ „ „ 600 „
The Diplosomidæ are confined to shallow water.
The Cœlocormidæ have only been found at a depth of 600 fathoms.
The Polystyelidæ range from 5 to 70 fathoms.

Hence it appears that, with the exception of the Cœlocormidæ, only known from a single specimen of *Cœlocormus huxleyi* obtained off the east coast of South America, there is no family peculiar to deep water; each of the others contains some species ranging from quite shallow water downwards. Four of the families, the Botryllidæ, the Polyclinidæ, the Didemnidæ, and the Cœlocormidæ, are represented in the abyssal zone,[1] while one other, the Distomidæ, is found at very considerable depths. The remaining two, the Diplosomidæ and the Polystyelidæ, are only known from depths of less than 100 fathoms.

The Polyclinidæ is the only family which extends into water of over 1000 fathoms, and it is only represented in such depths by one species (*Pharyngodictyon mirabile*). If this species were placed in an independent family, then the limit in depth of the Polyclinidæ, as now known, would be 600 fathoms.

In the Botryllidæ, although only one species (*Botrylloides fulgurale*) is abyssal, three genera are represented at considerable depths, viz., *Botrylloides* at 530 fathoms, and *Sarcobotrylloides* and *Polycyclus* both at 363 fathoms.

In the Distomidæ there is no peculiarly deep-water genus, but four species occur at depths of over 100 fathoms, viz., *Colella murrayi*, 120 fathoms, *Colella ramulosa*, 245 fathoms, ——— (*?*) *clava*, 450 fathoms, and *Cystodytes draschii*, 400 fathoms. The other species are all shallow-water forms.

In the Polyclinidæ, *Pharyngodictyon* is the only deep-water genus, but five species of the family, belonging to four distinct genera, extend into the abyssal zone. The other members of the family are nearly all confined to shallow water.

[1] Depths of 500 fathoms and upwards.

In the Didemnidæ there is one abyssal form, *Leptoclinum tenue*, but four other species extend to depths of over 100 fathoms.

If the range of depth at which Compound Ascidians were found (from the shore down to 1600 fathoms) be divided into zones, the following results will be arrived at :—

I.—Between the shore and 50 fathoms sixty species and varieties were found, viz. :—

Botrylloides tyreum.
„ *perspicuum.*
„ „ var. *rubicundum.*
„ *nigrum.*
Polycyclus jeffreysi.
Colella pedunculata.
„ *thomsoni.*
„ *gaimardi.*
„ *pulchra.*
„ *elongata*
„ *quoyi.*
„ *murrayi*, var. *rubida.*
„ *concreta.*
Distaplia vallii.
——— (?) *pyriformis.*
Cystodytes philippinensis.
Symplegma viride.
Tylobranchion speciosum.
Atopogaster elongata, var. *pallida.*
Morchellioides affinis.
Morchellium giardi.
Polyclinum pyriforme.
„ *fungosum.*
„ *depressum.*
„ *minutum.*
Aplidium fuscum.
„ *leucophæum.*
„ *crassum.*
„ *fallax.*
„ *fumigatum.*
Amaroucium variabile.
„ „ var. *tenerum*
„ *globosum.*

Amaroucium pallidulum.
„ *albidum.*
„ *nigrum.*
Psammaplidium spongiforme.
„ *ovatum.*
„ *pyriforme.*
Didemnum aurantiacum.
„ *inerme.*
Leptoclinum tonga.
„ *moseleyi.*
„ *speciosum.*
„ „ var. *asperum.*
„ *annectens.*
„ *albidum.*
„ „ var. *luteolum.*
„ *subflavum.*
„ *jeffreysi.*
„ *jacksoni.*
„ *rubicundum.*
Diplosomoides molle.
Diplosoma macdonaldi.
Goodsiria placenta.
„ „ var. *fusca.*
„ *pedunculata.*
„ *coccinea.*
Synstyela incrustans.
Chorizocormus reticulatus.

In this list twenty-two genera and six families are represented.

II.—Between 50 fathoms and 100 fathoms thirty-one species were found, viz.:—

Colella pedunculata.
„ *concreta.*
Tylobranchion speciosum.
Atopogaster gigantea.
„ *aurantiaca.*
„ *elongata.*
Morchellioides affinis.
Morchellium giardi.
Sidnyum pallidum.

Polyclinum pyriforme.
„ *incertum.*
„ *minutum.*
Aplidium fuscum.
„ *leucophæum.*
„ *despectum*
„ *fumigatum.*
Amaroucium variabile.
„ „ var. *tenerum.*
„ *globosum.*
„ *complanatum.*
„ *irregulare.*
„ „ var. *concinnum.*
„ *lævigatum.*
Psammaplidium exiguum.
„ *retiforme.*
———— (?) *ignotus.*
Leptoclinum albidum, var. *grande.*
„ *japonicum.*
„ *rubicundum.*
Goodsiria coccinea.
Synstyela incrustans.

In this list fourteen genera and four families are represented.

III.—Between 100 fathoms and 250 fathoms twelve species were found, viz.:—

Colella murrayi.
„ *ramulosa.*
Amaroucium complanatum.
„ *recumbens.*
„ *colelloides*
Psammaplidium subviride.
„ *retiforme.*
Didemnum savignii.
Leptoclinum tenue.
„ *propinquum.*
„ *albidum.*
„ *edwardsi.*

In this list five genera and three families are represented.

IV.—Between 250 fathoms and 500 fathoms four species were found, viz.:—

Sarcobotrylloides wyvillii.
Polycyclus lamarcki.
——— (?) *clava.*
Cystodytes draschii.

In this list four genera and two families are represented.

V.—Between 500 fathoms and 1000 fathoms seven species were found, viz.:—

Botrylloides fulgurale.
Polyclinum molle.
Aplidium incrustans.
Psammaplidium effrenatum.
„ *flavum.*
Leptoclinum tenue.
Cœlocormus huxleyi.

In this list six genera and four families are represented.

VI.—Between 1000 fathoms and 2000 fathoms one species was found, viz.:—

Pharyngodictyon mirabile.

From these lists it appears that Compound Ascidians, like Simple Ascidians, are much more common in shallow than in deep water, that only eight species extend into the abyssal zone, only one species to depths over 1000 fathoms, and that more than half the total number of species are found living at depths between 1 and 50 fathoms.

These lists, however, do not accurately represnt ethe whole state of affairs, as they do not take into account the greater facilities for collecting in shallow water, nor yet the relative numbers of the deep and the shallow water dredgings performed during the voyage.

Hence the following list, showing the number of dredgings taken by the Challenger Expedition in the different zones, and the proportion of them at which Compound Ascidians were found, is necessary in order to give a more complete idea of the bathymetrical distribution of the collection :—

In 32 dredgings at from 0–50 fathoms, Ascidiæ Compositæ occurred 16 times,[1] or at 50 per cent. of the Stations.								
„ 51	„	50–500	„	„	14	„	27	„ „
„ 23	„	500–1000	„	„	1	„	4	„ „
„ 94	„	1000–2000	„	„	1	„	1	„ „

The column of percentages brings out very clearly that the Compound Ascidians are mainly a shallow-water group, that they are abundant around coasts in a few fathoms of

[1] Including a few localities which were not Stations, such as Bermuda, Bahia, Simon's Bay, Port Jackson, &c.

water, and that they rapidly decrease in numbers as greater and greater depths are reached. They are not so well represented in the abyssal zone as the Simple Ascidians are, and, so far as is known, they do not extend to as great a depth. Twenty species of Simple Ascidians were found in the abyssal zone, and seven[1] species occurred at depths between 2000 and 3000 fathoms.

Just as in the case of the Ascidiæ Simplices, it does not seem possible to establish any relation between the occurrence of Compound Ascidians and the nature of the bottom. The shallow water forms are chiefly found on rocky and stony shores, and in many cases are attached to Zoophytes, Sponges, and Algæ. Those from deep water are found living on various kinds of deposit, including "volcanic mud," "green sand," "Globigerina ooze," "blue mud," "Diatom ooze," "rock," &c.

The temperature of the water appears also to have little influence upon the distribution of the Ascidiæ Compositæ, as the bottom temperatures at their localities show a considerable range, extending from a little above freezing point (34·2° F.) upwards to 71° F.

[1] To these numbers must be added the additional Simple Ascidians described i Appendix A, below.

SUMMARY AND GENERAL REMARKS.

The present section will consist of a brief summary of the chief additions made by the Challenger Expedition to our knowledge of the Compound Ascidians, along with a discussion, where necessary, of any structural points of interest or novelty. An account of the probable phylogeny of the group, and of its relations to the other Tunicata, will conclude this part of the Report. The remarks upon the different genera and species in the following pages are arranged in the same order in which the families were treated in the preceding systematic part of the work, beginning with the Botryllidæ and ending with the Polystyelidæ. This, as was pointed out in the Introduction, is a somewhat artificial arrangement. The natural relations of the families will be discussed further on, in connection with the phylogeny of the group.

The family Botryllidæ is represented in the collections by seven species and a well-marked variety, all new to science. It is remarkable that all the Challenger specimens belong to the genus *Botrylloides*, while *Botryllus*, which is so common on the coasts of north-west Europe, was not obtained in any of the expeditions. The Botryllidæ were all collected to the north of the equator, and the only tropical region in which they occurred was the Philippine Islands. No new genus has been required in this family. The name of the new species described on page 41 as *Botrylloides purpureum* I now change to *Botrylloides tyreum*, as the specific name *purpureum* was pre-occupied by a distinct species.[1]

The family Distomidæ is represented by fifteen species and a well-marked variety. It is a large group, including von Drasche's family Chondrostachyidæ, and a series of new forms, for which the genus *Colella* has been founded (see p. 72). This genus is allied to *Distaplia*, Della Valle, and to *Oxycorynia*, von Drasche; it contains nine species and a variety, all new to science with the exception of *Colella pedunculata*, described in 1834 under the name of *Aplidium pedunculatum* by Quoy and Gaimard. Most of these forms have the test of the lower part of the colony remarkably modified, so as to form a well-

[1] See von Drasche, Die Synascidien, p. 15.

marked peduncle, upon which the remainder of the colony (the "head"), containing the Ascidiozooids, is borne. Gemmation is effected by means of the vascular prolongations from the Ascidiozooids which penetrate the peduncle, and the history of the colony in *Colella* appears to be as follows:—The first Ascidiozooid produced by the fixing of the tailed larva forms the young test which grows rapidly at the side next the point of attachment, thus raising the Ascidiozooid upwards on a short stalk. A vascular prolongation from the posterior end of the body of the Ascidiozooid now grows downwards into the gradually increasing peduncle, and after a time forms one or more young buds, which become cut off from the vascular prolongation and lie in the test of the peduncle. These buds are now carried upwards by the constant growth of the peduncle at its base, so that eventually, when they are fully developed, they have reached what is now the upper part of the peduncle, and take their places in the "head" next to the Ascidiozooid from which they were originally produced. Meanwhile the vascular prolongation from that Ascidiozooid has been growing downwards still further through the peduncle and producing new buds. The young Ascidiozooids formed from the first buds in their turn produce vascular prolongations, and then buds in the peduncle. As the Ascidiozooids in the upper part of the colony or "head" grow older they produce true reproductive organs, and embryos are formed. These undergo their development in the incubatory pouch, a large diverticulum from the dorsal edge of the peribranchial cavity. The oldest Ascidiozooids and embryos in the colony finally reach the upper end, die, and decay, the fully developed tailed larvæ in the incubatory pouches being set free to swim away and found new colonies. From this account it is obvious that the test grows at the lower end of the colony, and is constantly dying and wasting away at the upper end, while each Ascidiozooid in the course of its life traverses the whole length of the colony (see p. 93).

On account of the large size of the Ascidiozooids in two of the species of *Colella*, of which there were duplicates in the collection, these forms were chosen for a detailed examination of the anatomy and histology (see pp. 74 and 94).

The pigmentation of some of the species of *Colella* is very striking. In *Colella thomsoni* the body of the Ascidiozooid is coloured of a deep indigo-blue, while in *Colella murrayi* the test contains great masses of opaque white pigment cells. The allied genus *Distaplia* also shows vivid pigmentation. *Distaplia vallii* is coloured by red, opaque white, and dark violet pigment cells.

Two new species were found belonging to *Cystodytes*, a genus characterised by the possession of discoid calcareous spicules in the test around the bodies of the Ascidiozooids. These spicules seem to be enclosed in membranous capsules, containing nuclei, and this fact, taken along with some observations made upon the relations of the spicules to the test in *Leptoclinum tonga* (see p. 269), seems to point to the origin of these calcareous spicules from groups of modified test-cells, the remains of which persist around the spicule in the form of a delicate membrane.

A new genus, *Symplegma* (p. 144), has been formed for a remarkable colony obtained at Bermuda. This form differs from all the other Distomidæ in having internal longitudinal bars in the branchial sac, but it is really very doubtful whether the genus ought to be placed in this family. I am rather inclined to suspect that *Symplegma* will turn out to be an aberrant form allied to the Botryllidæ (see p. 397).

The large family Polyclinidæ is represented in the Challenger collection by forty-three species and at least three well-marked varieties. One species (*Aplidium fallax*) was previously known, the rest are all new to science. Ten genera are represented, and five of these (*Pharyngodictyon*, *Tylobranchion*, *Atopogaster*, *Morchellioides*, and *Psammaplidium*) are new groups (see p. 151) formed for the reception of Challenger species.

The most remarkable form in the family is undoubtedly *Pharyngodictyon mirabile* (see p. 153), in which the branchial sac is in the curious degenerate condition found in *Culeolus* amongst Simple Ascidians. The internal longitudinal bars and the transverse vessels form a square-meshed network, which is not broken up into stigmata, as the system of fine longitudinal vessels seems to be entirely absent. This peculiar condition of the branchial sac seems to be associated with the abyssal zone, as it has apparently been evolved independently in at least four different groups of deep-sea Ascidians, viz., *Culeolus*, *Fungulus*, *Bathyoncus*, and *Pharyngodictyon*, while it has not been found in any forms from shallow water.

In *Pharyngodictyon* then, internal longitudinal bars are present in the branchial sac, while they are absent in all the other Polyclinidæ. In *Tylobranchion speciosum*, however, the transverse vessels bear curious papillæ (see Pl. XXII. fig. 7), which are probably rudimentary connecting ducts which have lost their proper function, as there are no internal longitudinal bars present to support them, but which have not yet disappeared. The branchial sac of *Tylobranchion speciosum* is therefore in an intermediate condition of degeneration between that of *Pharyngodictyon mirabile* and that of the other Polyclinidæ (see phylogeny of the group, p. 390).

The genus *Atopogaster* includes some new species of large size which have the stomach-wall more or less transversely folded, an unusual condition in Ascidians.

The curious group of species characterised by that irregularly thickened condition of the stomach-wall called areolated by Giard, is represented in the collection by three forms all new to science, viz., *Morchellioides affinis*, *Morchellium giardi*, and *Sidnyum pallidum*. The first of them (see p. 177) has eight lobes around the branchial aperture, while in most of the Compound Ascidians the branchial apertures are always six-lobed.

The remaining new genus, *Psammaplidium*, is closely allied to *Aplidium*, but has the test strengthened by imbedded sand-grains (see p. 237 and Pl. XXXI. fig. 9). It contains nine new species, all from the southern hemisphere.

The Polyclinidæ as a family are very widely distributed, but the majority of the Challenger species are from the far south.

The family Didemnidæ is represented by nineteen species and at least four varieties. One of the species (*Leptoclinum albidum*) was previously known, the other forms are all new to science. Nearly all of these species are opaque white or grey; a few, however, are pigmented. *Didemnum savignii* is a chocolate-brown, *Didemnum aurantiacum* is orange, and *Leptoclinum rubicundum* is of a rust red colour. The Didemnidæ have a world-wide distribution.

Some of the Challenger species of *Leptoclinum* form remarkably calcareous colonies, the spicules being very numerous and densely crowded in the test (see *Leptoclinum moseleyi*, p. 272). The relation of these calcareous spicules to the test matrix and cells is discussed in the case of *Leptoclinum tonga* (p. 269).

Two new species belonging to the interesting family Diplosomidæ were obtained during the Challenger Expedition. For one of them, along with a previously described species of von Drasche's (*Diplosoma pseudoleptoclinum*), I have founded the new genus *Diplosomoides*.

Probably the single colony of *Cœlocormus huxleyi*, which was obtained from a depth of 600 fathoms off the east coast of South America, is the most remarkable and important Compound Ascidian in the collection. It is an unattached massive colony, with an axial cavity. The branchial apertures of the Ascidiozooids are five-lobed, a condition not found in any other Ascidians. There are a few calcareous spicules in the upper layer of the colony, like those of the Didemnidæ; and the male reproductive organs are in an intermediate condition between those of the Distomidæ and of the Didemnidæ. On account of these and other remarkable peculiarities (see p. 317), I have found it necessary to establish a new family, the Cœlocormidæ, occupying an intermediate position between the Diplosomidæ and the Pyrosomidæ (see also under Phylogeny, p. 394).

The Polystyelidæ, a group which I have raised to the rank of a family, has important relations with the Cynthiidæ amongst Simple Ascidians (see under Phylogeny, p. 398), and is well represented in the Challenger collection. This family was only known previously from a few species obtained on the shores of north-west Europe, and a single species (*Goodsiria coccinea*) from the Strait of Magellan. To these the Challenger investigations have added four new species and a variety.

One new genus has been formed for *Chorizocormus reticulatus*, a species from Kerguelen Island which exhibits particularly well the gradual union of Ascidiozooids to form a colony (see p. 346).

The relations of this family to the Simple Ascidians on the one hand, and to the Botryllidæ on the other, are discussed in connection with the phylogeny of the Compound Ascidians further on (p. 398).

The new Challenger Polystyelidæ are nearly all from southern latitudes. Some of them form very large colonies, and the Ascidiozooids are much larger than in the case of most Compound Ascidians.

Although Compound Ascidians are probably all hermaphrodite if the entire life of the Ascidiozooid be taken into consideration, still it very often happens that particular Ascidiozooids when examined are found to have the reproductive organs of only one sex developed. This was the case in a number of the Challenger colonies, and in many of these cases I have been able to make out that the female organs develop first in the young Ascidiozooid, and then, after the ova have attained maturity and escaped, the male system begins to form, and is found in a fully developed condition in the adult Ascidiozooid only. I have found this protogynous arrangement in the following species, and it probably exists in many more:—

BOTRYLLIDÆ.

Botrylloides tyreum.
Botrylloides fulgurale.
Sarcobotrylloides wyvillii.
Polycyclus jeffreysi.

DISTOMIDÆ.

Colella pedunculata.
Colella thomsoni.
Colella gaimardi.
Colella quoyi.
Colella murrayi.
Colella ramulosa.

In a number of the Polyclinidæ and Didemnidæ also, only male reproductive organs were found in the Ascidiozooids examined, but in such cases it is not certain that the female system occurs only in the younger Ascidiozooids.

In *Cœlocormus huxleyi*, on the other hand, a protandrous condition appears to exist (see p. 322), the male organs developing first, and being succeeded later on in the life of the Ascidiozooid by the female system.

In some of the Polystyelidæ the polycarps are unisexual, and the male and female polycarps differ in appearance. In one species, *Goodsiria pedunculata*, only female polycarps were found in the Ascidiozooids examined, but whether this is a case of protogyny or protandry is not known. Possibly it may be due to a unisexual condition of the Ascidiozooids. It would not be surprising to find that in a group where the polycarps have become differentiated and heteromorphic, one or more species were unisexual.

Tailed larvæ were found in a number of the colonies examined, either in the peribranchial cavities of the Ascidiozooids or in a specially formed incubatory pouch (see *Colella pedunculata*, p. 89), or merely imbedded in the common test of the colony.

The following list, giving the species in which larvæ occurred, the dates when the

specimens were found, and the localities, may be of importance in connection with the determination of the times of the year at which Ascidians reproduce in different parts of the world.

TABLE SHOWING SPECIES OF COMPOUND ASCIDIANS IN WHICH LARVÆ WERE FOUND.

Species.	Locality.	Date.
Botrylloides nigrum,	Bermuda.	...
Sarcobotrylloides wyvillii,	Faroë Channel.	August.
Colella pedunculata,	Kerguelen Island and Strait of Magellan.	January and February.
Colella thomsoni,	Philippine Islands.	January 30.
Colella gaimardi,	Falkland Islands.	January 27.
Colella pulchra,	Torres Strait.	September 9.
Colella concreta,	Kerguelen Island.	January.
Distaplia vallii,	(1) Mediterranean, (2) Philippine Islands.	(1) August, (2) January 30.
——— (?) *pyriformis*,	Kerguelen Island.	January.
Cystodytes draschii,	Off Brazil.	September 10.
Polyclinum fungosum,	Port Jackson.	April.
Polyclinum molle,	East coast of Patagonia.	February 14.
Aplidium fallax,	Loch Foyle.	Summer.
Aplidium despectum,	Off Nova Scotia.	May 8.
Amaroucium pallidulum,	Falkland Islands.	January 27.
Amaroucium recumbens,	Strait of Magellan.	January 11.
Amaroucium colelloides,	South of the Cape of Good Hope.	December 18.
Psammaplidium exiguum,	Off Cape of Good Hope.	December 17.
Psammaplidium retiforme,	Kerguelen Island.	January 29.
Didemnum aurantiacum,	Bass' Strait.	April 2.
Leptoclinum tenue,	Patagonia.	January.
Leptoclinum albidum, var. *luteolum*,	Morocco.	August 5.
Leptoclinum jacksoni,	Port Jackson.	April.
Cœlocormus huxleyi,	East coast of Patagonia.	February 14.
Goodsiria placenta,	Simon's Bay.	December.
Goodsiria placenta, var. *fusca*,	Simon's Bay.	December.
Synstyela incrustans,	Strait of Magellan.	January 20.

Buds in various stages of development occurred in a number of species belonging to different families. The process of gemmation appears to be usually effected by means of vascular appendages or prolongations from the body of the parent Ascidiozooid. This process has been long known in the case of the Clavelinidæ, and has been more than once described in certain Botryllidæ (see *Sarcobotrylloides wyvillii*, p. 59); and I have been able to show that it also occurs in the genus *Colella* (p. 90).

In the Polyclinidæ the buds are formed from the post-abdomen, which, however, seems to be merely the enlarged upper part of a vascular appendage into which the reproductive organs have extended. The small knobs found on the end of the post-abdomen of some species of Polyclinidæ (*e.g.*, *Polyclinum molle*, p. 196, and *Amaroucium globosum*, p. 221) are, I believe, the rudimentary terminations of the modified vascular

appendage. In *Morchellioides affinis* (see p. 177) the post-abdomen terminates in distinct vessels which run for a short distance through the test and terminate in bulbs (see Pl. XXIV. fig. 17, *v.ap.*).

In the Botryllidæ the system of branched and anastomosing vessels in the test has become greatly enlarged, and probably forms an accessory organ of respiration.[1] The explanation of this system being so much more developed in the Botryllidæ than in the other Compound Ascidians is to be found in the evolution of the group. The Botryllidæ have probably sprung from the Simple Ascidians after these had acquired well-marked systems of respiratory vessels in their tests, while most of the other Compound Ascidians originated at an earlier point, while the vessels were still in the form of gemmiparous stolons (see under Phylogeny, below).

In those Distomidæ where the colony has become pedunculated (*e.g.*, *Colella*) the young Ascidiozooids are added at the base of the head, and those at the summit are the oldest; but in one species of the Polystyelidæ, *Goodsiria placenta*, the older Ascidiozooids seem to be next the peduncle, while the younger ones are at the upper end of the colony. In *Cœlocormus huxleyi* also the older Ascidiozooids seem to be in what must be regarded as the basal part of the colony. In all these cases the relative positions of the Ascidiozooids, and, to a certain extent, the shape of the colony, depend upon the method and the region in which gemmation is carried on.

Phylogeny.

The detailed investigation of the structure of the various groups of Simple and Compound Ascidians, and the consideration of their relationships, have gradually led me to the conclusion that the Ascidiæ Compositæ are polyphyletic in origin, being composed of several branches which have arisen from the Simple Ascidians at different times. Consequently, in order to explain the probable phylogeny of the Compound Ascidians, it will be necessary to refer to that of the Simple Ascidians discussed at the end of the first part of this Report.[2]

The ancestral Simple Ascidian there described, and which I regard as being also the common ancestor of all the Compound Ascidians, was probably derived from the Proto-Tunicata[3] after the separation of the Proto-Thaliacea and the primitive Appendicularriidæ (see fig. 11, p. 388). It was the first fixed Ascidian—the ancestral Tunicates, and the primitive Appendicularriidæ, Salpidæ, and Doliolidæ derived from them being all free

[1] See Herdman, On a New Organ of Respiration in the Tunicata, *Proc. Lit. and Phil. Soc. Liverpool*, vol. xxxix. p. 39, 1884–85.

[2] In vol. vi., 1882, part xviii. p. 285.

[3] For my views as to the origin of the Proto-Tunicata and their branches see A Phylogenetic Classification of Animals, Macmillan, 1885. A more detailed account of the probable phylogeny of the Tunicata, and of the relations of the Thaliacea to the other groups, will be given in the third and concluding part of this Report.

swimming—and the changes by which it was produced from the Appendicularia-like Proto-Tunicate were probably much the same series of degenerations of certain organs

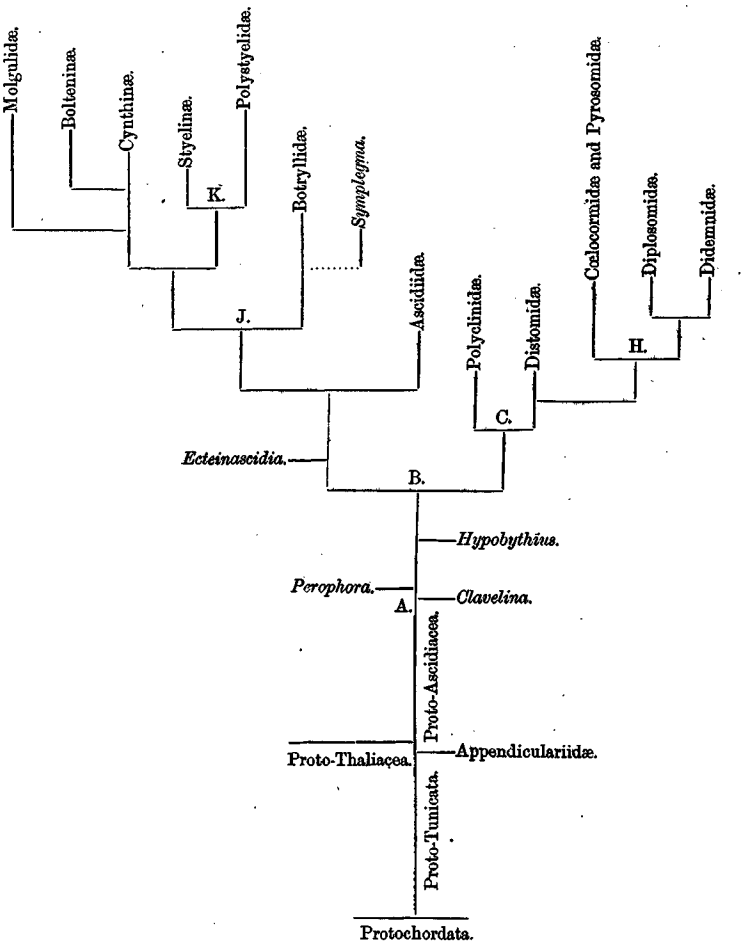


FIG. 11.—Diagram illustrating the phylogeny of the Tunicata.

and differentiation of others which are found taking place at the present day when the free-swimming tailed larva passes into the young Ascidian. The ancestors in which these changes took place, and which may be called Proto-Ascidiacea, are represented in

the accompanying diagram (fig. 11) by the line stretching from the splitting point of the Proto-Tunicata to the most recent common ancestor of Simple and Compound Ascidians (A. in diagram).

This latter form was probably something like a *Clavelina* without a peduncle. It was attached by the posterior end of the body, and was elongated antero-posteriorly. The branchial aperture was at the upper end, and the atrial far forward on the dorsal edge, and both were circular and without lobes. The branchial sac was not very large, and consequently the greater part of the alimentary canal lay posterior to it. No folds were present in the branchial sac, and the stigmata were straight. The tentacles were simple. Finally, by reproducing by gemmation, small colonies were produced. The buds were probably formed as simple outgrowths (containing some cells derived from the endoderm of the parent covered by a prolongation of the body-wall) from the posterior end of the body.

From this form (A. in diagram, fig. 11) several lines diverged. One led to the genus *Clavelina*, in which little change has taken place. The body has become elongated, and more or less pedunculated, while the buds have come to be produced on stolons which are prolongations of the body-wall of the parent Ascidiozooid covered by a layer of test and containing blood sinuses. A second line of descent, starting from A., has produced the genus *Perophora*, in which the body has become shortened antero-posteriorly, so that the alimentary canal has come to lie alongside the branchial sac. The third diverging line from A. is that representing the ancestors of the remaining Simple and Compound Ascidians. In these forms the branchial sac became complicated by the addition of internal longitudinal bars which were not previously present. The genus *Ecteinascidia*[1] is closely related to these ancestral forms.

At about this point (B. in fig. 11) the line split into two great series, the one leading to the more typical Compound Ascidians (the Polyclinidæ, the Distomidæ, &c.) and to *Pyrosoma*, and the other giving rise to the typical Simple Ascidians, and to the Botryllidæ and the Polystyelidæ. The first of these two important branches soon divided (at C. in fig. 11) into two lines of descent; the one leading to the Polyclinidæ, and the other through the Distomidæ to the Didemnidæ, the Diplosomidæ, the Cœlocormidæ, and finally the Pyrosomidæ. In both of these lines, and in their common ancestors from the point B. onwards, the power of reproducing by gemmation was retained and even increased, and the members of the resulting colonies became more closely united with one another than is the case in *Clavelina* and allied forms.

The line which leads from C. to the existing Polyclinidæ must have been occupied by a series of forms in which the body of the Ascidiozooid became more and more elongated antero-posteriorly, and finally divided more or less distinctly into three regions, the

[1] See Part I. of this Report (vol. vi., 1882), p. 239; and Sluiter, Ueber einige einfachen Ascidien, &c., Natuurkund. Tijdsch. v. Nederland. Indie, Bd. xlv. p. 160, 1885.

thorax, the abdomen, and the post-abdomen. Large colonies were formed, and the Ascidiozooids (produced by gemmation from the post-abdomen) composing the colony were so closely placed that their tests became united to form a continuous investing mass. On account of several young Ascidiozooids being usually produced from a single older Ascidiozooid in the colony, a more or less regular grouping into systems naturally took place, and then the atrial apertures of the various Ascidiozooids in a system coalesced to

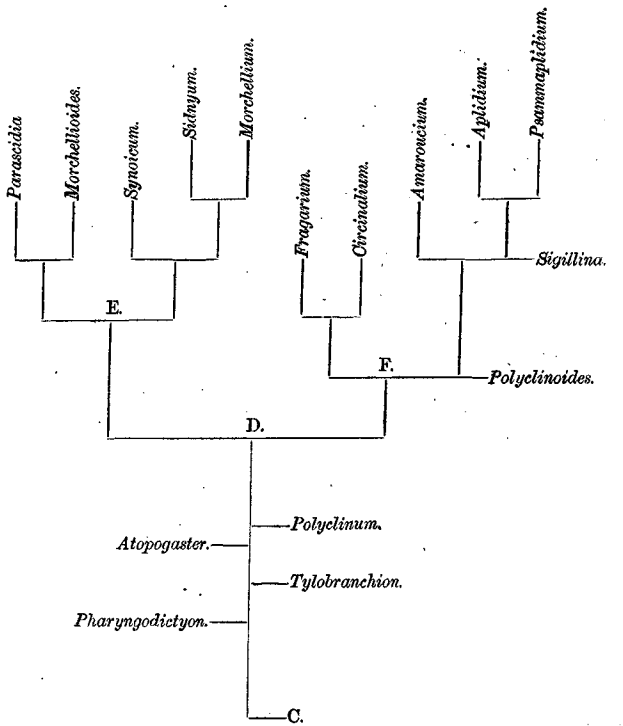


FIG. 12.—Diagram illustrating the phylogeny of the Polyclinidæ. C. indicates the point where the ancestral Polyclinidæ and Distomidæ diverged.

form a centrally placed common cloacal aperture. The branchial sac also underwent a gradual degeneration, resulting in the complete disappearance of the system of internal longitudinal bars inherited from the ancestral forms at B. (see fig. 11).

The central axis of the Polyclinidæ, extending from C. to D. (see fig. 12), was composed of a series of ancestral forms in which these and some other less important changes were gradually being effected, but from this axis a few short side branches were given off at

different periods. First, not very far from the point C. (see fig. 12), a line of descent diverged leading to the remarkable deep-sea genus *Pharyngodictyon* (see p. 153). The ancestors of this form must have diverged from the axis of the Polyclinidæ, while internal longitudinal bars were still present in the branchial sac, since these vessels (according to the interpretation of the structure given above, p. 155) are now present in *Pharyngodictyon*. In this side branch leading to *Pharyngodictyon*, however, a remarkable degeneration of the branchial sac took place, resulting in the total suppression of the system of fine interstigmatic vessels.

The second side branch from the Polyclinidæ, that leading to the genus *Tylobranchion*, appears to have left the main axis just about the point where the internal longitudinal bars in the branchial sac were disappearing, as *Tylobranchion* now shows no internal longitudinal bars, but possesses a system of papillæ which there is reason to believe are rudimentary connecting ducts, and which sometimes give off projections resembling the rudiments of internal longitudinal bars found attached to the free ends of the connecting ducts in some Simple Ascidians (see p. 161). *Pharyngodictyon* and *Tylobranchion* then, if the structure of their branchial sacs has been rightly interpreted, furnish us with valuable clues to the process of degeneration which went on in the ancestral Polyclinidæ.

The genus *Atopogaster*, which may be placed upon a third short twig given off from the axis of the Polyclinidæ (see fig. 12), differs very slightly from typical members of the family. The only modification of importance which occurs in this genus is in the structure of the stomach. The wall of this organ is thrown into a series of more or less distinct transverse folds, a condition never found in the other genera of the family.

The last side branch from the axis previous to its division into two at D. is the line leading to the genus *Polyclinum*, characterised by its smooth-walled stomach, its twisted intestine, and its laterally placed post-abdomen (see p. 186). It is a little difficult to determine the relations between *Atopogaster* and *Polyclinum*. In all probability the stomach in the ancestral Polyclinidæ was smooth-walled, while in all the higher forms of the family it is irregularly thickened either by the formation of a number of short cæca, or by being thrown into longitudinal folds. The first of these conditions is probably derived from the last, consequently the ancestor occupying the point D. (see fig. 12) had a longitudinally folded stomach-wall. Possibly *Atopogaster* diverged from the axis at the period when the tendency towards the formation of a ridged or thickened stomach-wall was being developed, and then after its separation the folds became formed more or less transversely in place of longitudinally. The line leading to *Polyclinum* probably diverged from very much the same point, and then the incipient folds in the stomach-wall were lost, and the other peculiarities of the genus acquired. *Polyclinum* cannot well be a more primitive form derived from the axis at a point before the formation of a thickened stomach-wall, as it shows no traces of internal longitudinal folds in its branchial sac, and

besides agrees with *Atopogaster* and the genera above it in most of the other points in its structure.

At the point indicated by D. in the diagram (fig. 12) the axis of the Polyclinidæ divided into two lines of descent, the one leading to an ancestral form in which the stomach-wall was areolated (see p. 177), while the second leads to a form F. in which the stomach-wall is thrown into well-marked longitudinal folds. The short cæca in the areolated condition are probably formed by the breaking up of longitudinal folds, since in *Morchellioides affinis*, a form derived from E., the cæca in the stomach-wall are distinctly arranged in longitudinal rows (see p. 179).

At the point E. two lines of descent were formed, in one of which the branchial aperture of the Ascidiozooid became eight-lobed, while in the other it remained six-lobed, the condition in which it is found in most Compound Ascidians. The ancestors with eight-lobed branchial apertures gave rise (see fig. 12) to the genera *Parascidia* and *Morchellioides* (see p. 177); while the other line of descent has split up into *Synoicum* and the closely allied forms *Sidnyum* and *Morchellium*.

The modification of the branchial aperture seen in *Parascidia* and *Morchellioides* is also found in some of the descendants of F. These forms, characterised by an eight-lobed branchial aperture, have given rise to the genera *Fragarium* and *Circinalium*, and the modification has apparently been formed independently in this branch, since both of these genera have well-marked longitudinal folds in the stomach-wall. The other line of descent derived from F. (see fig. 12) has given rise to the closely allied genera *Aplidium* and *Amaroucium*, which may be regarded as typical Polyclinidæ, and some closely related forms. The genus *Polyclinoides* was probably derived from a side branch between F. and the ancestral form of *Amaroucium*. *Sigillina* seems to be an offshoot from the ancestors of *Aplidium*. *Psammaplidium* is an interesting form also derived from the old and well-known genus *Aplidium*, by a modification of the test, which has acquired the property of taking up and growing over sand-grains and other foreign bodies, so that they become a part of the investing mass (see p. 237).

The second line leading from the point C. (in fig. 11, p. 388) gave rise first to the main axis of the Distomidæ (see fig. 13), and here, just as in the case of the early Polyclinidæ, a series of changes must have taken place, resulting in the formation of large colonies in which the Ascidiozooids were more or less completely imbedded in a common investing mass formed by the fusion of their tests. The union of the atrial apertures to form common cloacal cavities apparently did not take place so soon as in the case of the Polyclinidæ, as in many of the Distomidæ the atrial apertures of the Ascidiozooids are still found opening independently on the exterior of the colony.

The line leading from the point C. (fig. 13) to the early Distomidæ gives off a short side branch to the genus *Diazona*. This remarkable form, although not situated upon the main axis, is probably the nearest form now known to the common ancestor C.

which gave rise to most of the Compound Ascidians. *Diazona* diverged from the main line before the Ascidiozooids became completely imbedded in the common test, and just before the suppression of the internal longitudinal bars in the branchial sac took place, as these vessels are still present in *Diazona*, although absent in *Chondrostachys*, the next genus which left the main axis (see fig. 13). In the line leading to *Chondrostachys* the basal part of the colony became enlarged and prolonged to form

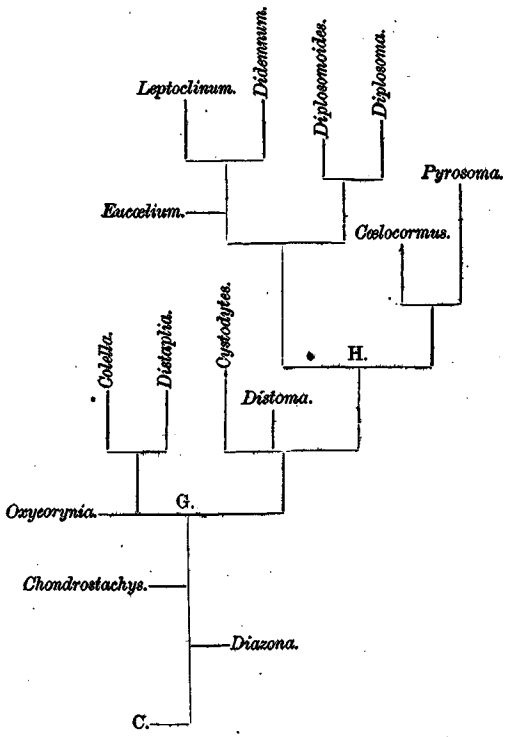


FIG. 13.—Diagram illustrating the phylogeny of the Distomidæ, Cœlocormidæ, Pyrosomidæ, Diplosomidæ, and Didemnidæ. C. indicates the point where the ancestral Polyclinidæ and Distomidæ diverged.

a peduncle, supporting the upper part in which the Ascidiozooids are placed. As in the case of *Diazona*, the Ascidiozooids are not completely imbedded in the test, but have their anterior ends partially free. In all the forms above this, however (see fig. 13), a true colony is formed by the complete union of the tests, so as to bury all the Ascidiozooids in a common investing mass.

At the point G. the main axis of the Distomidæ divided into two lines of descent:

a smaller branch leading to the genera *Oxycorynia*, *Colella*, and *Distaplia*, and a more important one, which has given rise to all the remaining forms (see fig. 13). In the ancestral forms of *Oxycorynia*, as in those of *Chondrostachys*, a peduncle has been formed, while the upper part of the colony forms an enlarged mass, the head, in which the short-bodied Ascidiozooids are imbedded.

The Ascidiozooids probably underwent very little change in form after they diverged from the ancestral Polyclinidæ at the point C. (fig. 11), and no antero-posterior elongation like that of the Polyclinidæ has taken place. In the genera *Colella* and *Distaplia* a remarkable modification of the peribranchial cavity has been effected, resulting in the formation of a large incubatory pouch in which the embryos undergo their development (see p. 89).

The chief branch springing from the point G. (fig. 13) gave rise, with very little change, to the well-known genus *Distoma*, and the allied form *Cystodytes*. This latter genus is similar to *Distoma* in most respects, but differs from it in having a remarkably modified test, in which discoid calcareous spicules are produced (see p. 135).

From the ancestors of *Distoma* a series of forms arose in which, while the general characters of the Distomidæ were preserved, some important changes were effected in the test and in the reproductive organs. The test cells acquired the property of producing spherical or stellate calcareous spicules, while the vas deferens assumed gradually the spirally coiled form which is so characteristic of the Didemnidæ (see p. 254). This ancestral line divided at the point H. into two branches, one leading with comparatively little change to the Didemnidæ and the Diplosomidæ, and the other producing the remarkable *Cœlocormus*, and eventually *Pyrosoma* (see fig. 13). In this second line diverging from H. the ancestral condition of the male reproductive organs found in the Distomidæ was retained, along with the partially coiled arrangement of the vas deferens which was present in H., and which afterwards became emphasised in the Didemnidæ. At the same time the colony became detached, and its upper surface sank in so as to produce an axial cavity, the lining of which is really morphologically a part of the outer surface of the colony (see p. 318), thus giving rise to the genus *Cœlocormus* (fig. 14, B).

The value of *Cœlocormus* as a transition form between the ordinary Compound Ascidian colony, such as a species of *Distoma* (fig. 14, A), and the pelagic *Pyrosoma* (fig. 14, C) has already been pointed out in the systematic part of this Report (see p. 319). *Pyrosoma* has probably descended from an ancestral form, allied to *Cœlocormus*, by slight changes in shape, resulting in the formation of an elongated hollow cylinder, and by a modification in the relations of the Ascidiozooids whereby they came to open independently into the large axial cavity, which is thus virtually converted into a huge common cloacal cavity (see fig. 14, C.). The colony is free-swimming, and the Ascidiozooids have acquired light-producing organs placed laterally on their anterior ends in the positions occupied by the masses of pigment cells in *Polycyclus jeffreysi* (see p. 68).

Pyrosoma, then, may be regarded as a highly modified form derived from the ancestral Didemnidæ (H. in fig. 13), and much more closely allied to the ordinary Compound Ascidians, such as the Distomidæ and the Polyclinidæ, than to the other pelagic Tunicates, such as a colony of Salpæ.

The ancestral Didemnidæ which were derived from the point H. divided into two series, those leading to the Didemnidæ proper, and those which have given rise to the Diplosomidæ. From the former, near the point of division, arose the side branch leading to the genus *Eucœlium*, where the number of rows of stigmata in the branchial sac is greater than three or four, thus resembling most of the ancestral Distomidæ, from which the Didemnidæ were derived. In the family Didemnidæ the property of producing calcareous spicules in the test has reached its greatest development. Similar spicules (apparently

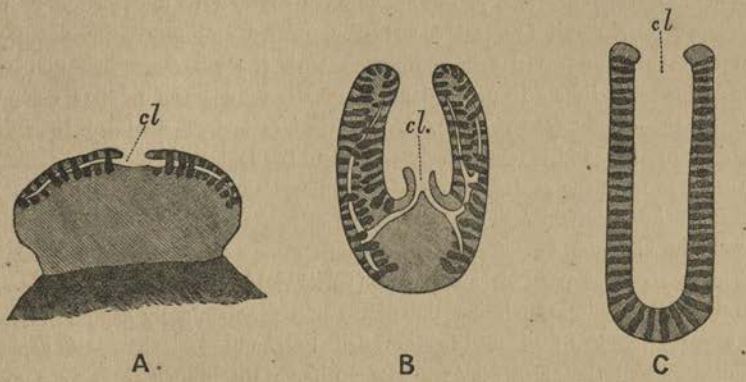


FIG. 14.—Diagrams showing the relations between—A, a typical Compound Ascidian; B, *Cœlocormus;* C, *Pyrosoma*. In all cases the colonies are represented in longitudinal section, and *cl.* indicates the opening of the common cloacal cavity.

in all cases formed by modified test cells, see p. 271) are found also in the Diplosomidæ and in the Cœlocormidæ, and a somewhat different form of spicule occurs in the genus *Cystodytes*, consequently it is possible that the tendency towards the formation of calcareous deposits by the test cells was developed as far back as the ancestors of the genera *Distoma* and *Cystodytes* (see fig. 13), and if so, then the tendency has been repressed in the species of *Distoma*.

In the ancestral Didemnidæ the male reproductive organs became concentrated to form a single large ovate testis around which the long vas deferens was coiled spirally (see p. 254). The genus *Didemnum* is rather less modified than *Leptoclinum*, which forms the termination of this branch. In *Leptoclinum* the colony has become greatly flattened from above downwards so as to form in most cases a mere incrusting film in which the test is usually densely crowded with calcareous spicules. One result of this flattening of the colony in the more modified Leptoclinids is that remarkable bending of the body

of the Ascidiozooid which has been already described in the case of *Leptoclinum moseleyi* (see p. 273), where it has resulted in the abdomen having come to lie at right angles to the thorax in place of being in the same straight line with it. In other cases the Ascidiozooids have remained unflexed, but have become scattered irregularly in the test inclined at various angles to the surface of the colony.

In the ancestral Diplosomidæ the reproductive organs have remained in a more primitive condition than in the Didemnidæ, and the vas deferens has become straightened. The testes are usually two in number, and are therefore in an intermediate state between the numerous spermatic vesicles of the ancestral Distomidæ and the single large testis of the Didemnidæ. The property of producing calcareous spicules in the test has become gradually lost in the Diplosomidæ. Spicules are still found in the upper layer of the colony in *Diplosomoides* (see p. 309), but have completely disappeared in the genus *Diplosoma*. As a result the test has become softer and more transparent, and the system of canals and cavities in connection with the common cloacal apertures has become at the same time so increased as to greatly reduce the relative amount of test present in the colony (see p. 308). *Diplosomoides* is less modified than *Diplosoma* (see fig. 13, p. 393), and is more nearly related to the Didemnidæ.

In order to trace the evolution of the remaining Compound Ascidians, it is necessary to return to the ancestral Ascidian allied to *Ecteinascidia* (B. in fig. 11, p. 388). This form was the common ancestor of the various groups of Simple Ascidians, and it is described in the first part of this Report (vol. vi., 1882, p. 285). It gave rise to an ancestral series which, after losing the power of reproducing by gemmation and undergoing a certain amount of modification, led to *Ciona* and the other genera of the Ascidiidæ.[1] From the ancestral Ascidiidæ an important branch leads to a great series of forms in which the body has become shortened antero-posteriorly by the alimentary canal being placed alongside the branchial sac instead of extending behind it, while the branchial sac has become more highly developed and has had its surface greatly increased by being thrown into a series of longitudinal folds. Before this last change took place, however, the branch probably divided (at J. in fig. 11, p. 388) into two ancestral series, one leading to the family Botryllidæ and the other to the primitive Cynthiidæ (see fig. 11, J.).

In the long line of descent leading from the point J. to the family Botryllidæ the lost property of reproducing by gemmation was regained, and as a result colonies were once more produced. The Ascidiozooids in these primitive Botryllidæ were completely imbedded in a common test, and they became arranged in systems as in the case of the Polyclinidæ, and finally in each system all the atrial apertures came to open into a

[1] For the phylogeny of the Simple Ascidians see Part I. of this Report in vol. vi., 1882, Summary, p. 285. The subject will be discussed more in detail in Part III. of this Report, where the relationships between the various groups of the Tunicata will be fully considered.

centrally placed common cloacal cavity. The test became penetrated by a well-developed system of blood-vessels with enlarged terminal bulbs in the superficial layer of the colony, forming in all probability an accessory organ of respiration. This system is evidently the same as that found in the test of some of the Ascidiidæ, and it has been inherited by the Botryllidæ from their ancestors amongst the Ascidiæ Simplices. The Simple Ascidians in their turn inherited the blood-vessels of the test from their ancestors the primitive Clavelinidæ (see fig. 11, p. 388), in which these structures were limited to the posterior end of the body and the stolons. This system in the Clavelinidæ was originally a bud-producing apparatus, and when the property of gemmation was lost (in the Ascidiidæ) it became useful as an accessory organ of respiration,[1] and was seized upon and evolved by the action of natural selection into the complicated system of vessels and bulbs found in some Ascidiidæ and Botryllidæ. It is interesting to find that in the Botryllidæ, where the property of gemmation has been acquired, the vessels in the test have in some cases (*e.g.*, *Sarcobotrylloides wyvillii*, see p. 59) returned to their original function of producing buds in their terminal enlargements.

The branchial sac in the Botryllidæ is well developed, and agrees with that of the Simple Ascidians from the point B. (fig. 11, p. 388) onwards in having well developed internal longitudinal bars. The reproductive organs are found in a condition which suggests the close relationship with the ancestral Cynthiidæ, which is shown in the diagram (fig. 11, p. 388).

The genus *Symplegma*, as I have already pointed out (p. 144), unites the characters of the families Distomidæ and Botryllidæ. In the systematic part of this Report I placed *Symplegma* with some hesitation in the Distomidæ, but I am rather inclined now to regard it, on account of the structure of its branchial sac and dorsal lamina, as being more closely related to the Botryllidæ than to the Distomidæ, and therefore I have placed it provisionally in the phylogenetic table (fig. 11, p. 388) on the termination of a side branch from the ancestral Botryllidæ.

For the different conditions of colony, systems, and Ascidiozooids found in the four genera of the Botryllidæ I may refer to the systematic part of this Report (see p. 37), where they are described and their probable relations discussed. The ancestral Botryllidæ, with moderately thick colonies, probably divided into two series; one—with regular stellate systems and ovate Ascidiozooids—leading to (1) *Botryllus*, in which the colony became thin and incrusting, and (2) *Polycyclus*, in which the colony became thick and massive; and the other—with elongated irregular systems and cylindrical Ascidiozooids—giving rise (1) to *Botrylloides* with thin colonies, and (2) to *Sarcobotrylloides* with thickened colonies (see fig. 15, p. 398). The manner in which the systems probably became complicated, and in which the Ascidiozooids may have changed their form as a result of the modification of the systems, has already been described (see p. 40).

[1] See Herdman, On the Evolution of the Blood-Vessels in the Test of the Tunicata, *Nature*, vol. xxxi. p. 247.

The primitive Cynthiidæ derived from the ancestral form J. (fig. 11, p. 388) acquired longitudinal folds in the branchial sac and then divided into two series, the one leading to the Styelinæ and the Polystyelidæ, and the other giving rise to the remaining Cynthiidæ and the Molgulidæ. In the primitive Styelinæ the tentacles remained simple, as they were in the ancestral Simple Ascidians, and the number of folds in the branchial sac became limited to four on each side. The reproductive organs assumed the form of two or more hermaphrodite masses (called polycarps) attached to the inner surface of the mantle upon each side of the body. At the point K. (fig. 11, p. 388) these ancestral forms divided into two series, those leading to the true Styelinæ on the one hand, and to the primitive Polystyelidæ on the other.

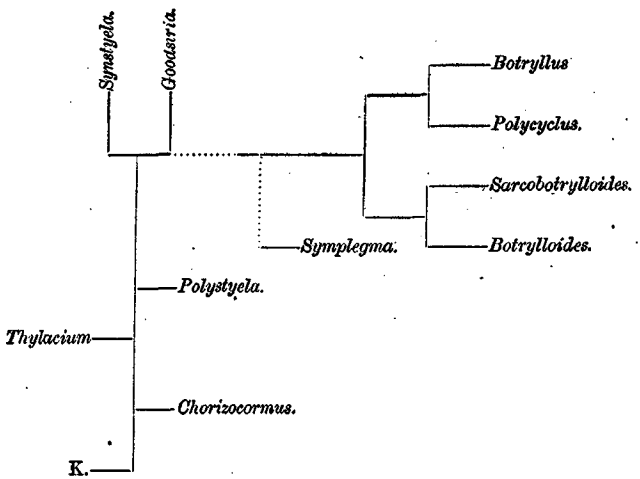


FIG. 15.—Diagram illustrating the phylogeny of the Polystyelidæ and the Botryllidæ, and their possible connection. K. indicates the point where the Polystyelidæ diverged from the Styelinæ.

The genus *Chorizocormus* is an important transition form between the Styelinæ and the Polystyelidæ proper (see p. 345). It is probably the nearest form known to the ancestral Polystyelidæ, and may therefore be placed (see fig. 15) on a short side branch springing from the axis of the Polystyelidæ not far above the point K.

Thylacium and *Polystyela* are derived from side branches between the ancestral *Chorizocormus* and the ancestral *Synstyela* or *Goodsiria*. They have the Ascidiozooids projecting somewhat above the general surface of the colony, and therefore bear much the same relation to the higher Polystyelidæ that the genus *Diazona* does to the typical Distomidæ. The axis of the Polystyelidæ finally divides into two branches, allowing the two most highly evolved forms in the family, *Synstyela* and *Goodsiria*, to diverge in opposite directions (see fig. 15). In *Synstyela* the colony has become thin and incrusting,

while in *Goodsiria* the test is greatly enlarged, thus rendering the colony thick and massive. In none of the Polystyelidæ have the Ascidiozooids come to be arranged in systems, and no common cloacal cavities have been formed; the atrial apertures of all the Ascidiozooids open independently upon the exterior of the colony. In this respect the colony is in the same stage of differentiation as that reached by most of the Distomidæ, while the other groups of Compound Ascidians (*e.g.*, Botryllidæ, Polyclinidæ, Didemnidæ) have advanced a stage further by the formation of systems with common cloacal cavities.

It is possible that the family Botryllidæ may have a closer relationship with the Polystyelidæ than I have assigned to it above (p. 396). The primitive Botryllidæ, in place of arising from the primitive Cynthiidæ, may possibly have been derived from the Polystyelidæ near the point where *Synstyela* and *Goodsiria* diverged, as is shown by the dotted line in the diagram (fig. 15). In that case the evolution of the primitive Botryllidæ would consist in the gradual formation of systems in the colony, and the complete disappearance of all traces of folds in the branchial sac.

Probably the two most important conclusions I have arrived at in these phylogenetic investigations are—(1) as to the relationship of *Pyrosoma*, and (2) as to the polyphyletic origin of the Ascidiæ Compositæ. *Pyrosoma*, although now a pelagic free-swimming organism, was probably derived from the fixed Compound Ascidians. The discovery of *Cœlocormus huxleyi* shows the relationship between *Pyrosoma* and the primitive Didemnidæ, and the latter in their turn were derived from the primitive Distomidæ; consequently, *Pyrosoma* is directly related to the most typical of the Compound Ascidians.

The Ascidiæ Compositæ, or Synascidæ, are really an unnatural assemblage of groups, as they seem to have been derived from the Simple Ascidians or their ancestors at two or three distinct points (see fig. 11, p. 388). The result of this is that the so-called Compound Ascidians form three[1] groups—(1) the Polystyelidæ, (2) the Botryllidæ, and (3) the remaining families—which are more nearly related to particular groups of Simple Ascidians than they are to one another. This conclusion renders it even more difficult than it was before to draw any line of demarcation between Simple and Compound Ascidians.

[1] Possibly (1) and (2) may have had a common origin, as is shown in fig. 15, p. 398.

APPENDIX A.

SUPPLEMENTARY REPORT UPON THE ASCIDIÆ SIMPLICES.

Since the publication of the First Part of this Report in 1882, several specimens of Simple Ascidians belonging to the Challenger collection have been sent to me for examination. Some of these were found in the bottles at the Challenger office, while others had been returned by the naturalists who were working at other groups in which specimens of Ascidians had been accidentally included. One of these was a new species of the interesting genus *Culeolus*, and this reached me just in time to be noticed in Part I. (see p. 276). Another (*Bathyoncus discoideus*) is a very remarkable specimen attached to a manganese nodule from deep water. This form and another smaller species (*Bathyoncus minutus*) may probably be referred to the genus *Bathyoncus* formed in the first part of the Report for the species *Bathyoncus mirabilis*, also an abyssal form.

The remaining species described below have no very remarkable peculiarities, and they fall naturally into well-known genera. With the exception of a new species of *Ciona* from Japan, they all belong to the family Cynthiidæ.

Two species belonging to the "Porcupine" collection, which have reached me since the publication of the Report upon the Simple Ascidians of the "Lightning" and "Porcupine" Expeditions,[1] are also included in this Appendix. One of them is a new species of *Molgula*, which has straight stigmata in the branchial sac, and therefore indicates a transition towards the Cynthiidæ.

Family MOLGULIDÆ.

The following is an interesting newspecies of *Molgula*, which was obtained from a depth of 440 fathoms in the North Atlantic.

Molgula carpenteri, n. sp. (Pl. XLVII. figs. 1, 2).

External Appearance.—The shape is ellipsoidal or nearly spherical, and the body is not attached. The edges are rounded, and there is slight lateral compression. Both

[1] *Trans. Roy. Soc. Edin.*, vol. xxxii. part ii. p. 219, 1884.

apertures are placed on the wide anterior end; they are moderately far apart, and are sessile and inconspicuous. The branchial aperture is six-lobed and the atrial four-lobed. The surface is entirely covered with a thick coating of sand. The colour is yellowish-brown.

The length of the body is 3 cm., the greatest breadth is 2·3 cm., and the thickness is 1·8 cm.

The Test is thin but moderately tough.

The Mantle is thin and membranous. The musculature is not strong, but it is in the typical Molgulid condition; the bodies of the muscles are wide, and the tendons are long and slender.

The Branchial Sac is large. There are five distinct folds upon each side. The internal longitudinal bars are straight and strong. There are about eight bars upon each side of a fold, and six in the interspace between two folds. The transverse vessels are placed far apart, and they are of two sizes, which occur alternately. Three delicate horizontal membranes are found between each pair of transverse vessels. The stigmata are straight, and they are very long. The ciliated cells are distinct.

The Dorsal Lamina is a membrane marked with slight transverse ribs. Its free margin is irregular, but is not distinctly toothed.

The Tentacles are large and much branched. There are eight large and a number of smaller intermediate ones.

Locality.—Station 51 (of "Porcupine" expedition in 1869); lat. 60° 6′ N., long. 8° 14′ W.; depth, 440 fathoms; date, August 17, 1869.

Several specimens[1] of this interesting new species of *Molgula* were obtained during the cruise of the "Porcupine" in the summer of 1869, off the north-west coast of Scotland, from a depth of 440 fathoms. It is a moderately large species, and all the specimens are of much the same size. The external appearance (Pl. XLVII. fig. 1) is not unlike that of *Molgula occulta*, Heller, but the internal structure is very different.

When the thin but sandy test is removed the mantle is seen to be very transparent. The course of the alimentary canal and the position of the long narrow reproductive organ upon each side of the body are clearly visible. The musculature is delicate, but most beautifully marked. The fusiform muscle bands are conspicuous in the transparent membranous mantle. The endostyle is narrow and straight.

The folds in the branchial sac are well-marked. They are of the very unusual number of five on each side. *Molgula chrystallina*, Møller, has the same number of folds, but is a very different species,[2] in which the test is not incrusted and the stigmata in the branchial sac are in the usual spiral condition. The most remarkable

[1] I am indebted to Dr. P. Herbert Carpenter, F.R.S., for having kindly sent me these specimens for examination.

[2] See Traustedt, Oversigt over de fra Danmark, &c., Ascidiæ Simplices, and Ascidiæ Simplices fra det Stille Ocean, *Vid. Meddel. nat. Foren. Kjøbenhavn*, 1880 and 1885.

feature in the present species is the shape of the stigmata. They are perfectly straight (Pl. XLVII. fig. 2, *sg.*), and in this respect differ from those of the other Molgulidæ. The only approach to this extraordinary condition is what is seen in the branchial sacs of *Ascopera pedunculata* and of *Molgula pedunculata*, where the stigmata are sometimes straight and sometimes curved.[1] They are never, however, arranged in regular transverse rows as they are in the case of the present species (Pl. XLVII. fig. 2, *sg.*). This structure of the branchial sac seen in *Molgula carpenteri* is exactly like that of most species of the Cynthiidæ, and in this respect the present species and *Ascopera pedunculata* form a perfect transition from the typical Cynthiid to the typical Molgulid condition. *Molgula carpenteri* is, however, notwithstanding its straight and regularly arranged stigmata, an undoubted *Molgula*. The other organs of the body have all the characteristics of the Molgulidæ, and the fact that an approach to the straight condition of the stigmata is found in *Molgula pedunculata* prevents the new species being raised to generic rank.

Family CYNTHIIDÆ.

Most of the species described in this Appendix belong to this, the largest family of the Simple Ascidians, and the three subfamilies, the Bolteninæ, the Cynthinæ, and the Styelinæ, which were formed in the First Part of this Report, are all represented.

Subfamily 1. BOLTENINÆ.

This group of the Cynthiidæ is represented by a new species of the remarkable deep-sea genus *Culeolus*. I have named it in memory of Dr. R. von Willemoes-Suhm, who was the first naturalist to examine a species of the genus (*Culeolus perlatus*,[2] Suhm).

Culeolus willemoesi, n. sp. (Pl. XLVIII. figs. 1–4).

External Appearance.—The body is fusiform in shape, and the peduncle is very long and slender. The widest part is about the middle of the body, and both the ends taper to narrow points. The anterior end passes gradually into the peduncle. The dorsal edge is rather more convex than the ventral. The two sides are about equally rounded. The peduncle is slight, but moderately tough. It springs from the anterior end of the body immediately on the ventral side of the branchial aperture, and it runs at first anteriorly and then turns dorsally and posteriorly, and then goes straight to its base of attachment. The apertures are both conspicuous. The branchial is placed close to the

[1] See Part I. of this Report, pp. 65 and 74.

[2] See Part I. of this Report, p. 115.

peduncle on its dorsal edge. It is triangular in shape and is surrounded by a somewhat circular raised margin. The atrial aperture is large, and has the form of a transverse slit. It is placed on the dorsal edge of the body more than half way back.

The surface is smooth in most places, but there are two projections on the ventral side of the peduncle at the anterior end of the body. A broad band of small pointed tubercles runs longitudinally along the ventral edge, and two narrow lines run transversely one behind the branchial aperture and another in front of the atrial. The latter terminates ventrally at the most posterior point of the body in a slight toothed ridge. The colour is a dull opaque grey.

The length of the body (antero-posterior) is nearly 1 cm. The breadth of the body (dorso-ventral) is 6 mm. The length of the peduncle is about 7 cm. The thickness of the peduncle is 0·5 mm.

The Test is thin but tough and opaque.

The Mantle is moderately strong.

The Branchial Sac has several slight folds upon each side; each fold is formed of three or four internal longitudinal bars. The transverse vessels are narrow; they are all of the same size, and are placed rather far apart. The internal longitudinal bars are much stronger and more closely placed. The meshes are vertically elongated. Calcareous spicules are present in the internal longitudinal bars, and occasionally extend into the transverse vessels; they are not numerous, but are large and slightly branched.

The Tentacles are pinnate. They are provided with spicules.

Locality.—Station 241, June 23, 1875; lat. 35° 41′ N., long. 157° 42′ E.; depth, 2300 fathoms; bottom temperature, 35°·1 F.; bottom, red clay.

One specimen of this new species of *Culeolus* was dredged at Station 241, in the Pacific Ocean, to the west of Japan, from the great depth of 2300 fathoms. The large species *Culeolus murrayi* was obtained at the same locality.

Culeolus willemoesi is the smallest species of *Culeolus* known. It differs from *Culeolus recumbens* and *Culeolus perlucidus* in having the peduncle running anteriorly from the body; it differs from *Culeolus perlatus* and from *Culeolus murrayi* in having no marked band of tubercles around the atrial aperture; and lastly, it differs from both *Culeolus wyville-thomsoni* and *Culeolus moseleyi* in the surface of the test, which is neither perfectly smooth, as in *Culeolus wyville-thomsoni*, nor yet evenly roughened all over as in *Culeolus moseleyi*. It also differs from *Culeolus murrayi*, *Culeolus wyville-thomsoni*, and *Culeolus moseleyi* in the position of the atrial aperture, and from *Culeolus recumbens* and *Culeolus perlucidus* in the shape of the body. In some respects it is more like *Culeolus perlatus* than any of the previously described species, but differs from it in the peduncle, the branchial aperture, the surface of the test, and other points.

The posterior end is long and pointed, giving the body as a whole a fusiform shape (see Pl. XLVIII. fig. 1). The apertures are distinctly marked. The branchial is triangular (Pl. XLVIII. fig. 3) and lies in an elliptical depression, surrounded by a raised margin cleft into a number of segments (Pl. XLVIII. fig. 3). It is rather a small aperture, and the apex of the triangle points posteriorly, the base being next to the peduncle. The atrial aperture seems larger, but unfortunately it is torn in the only specimen of the species. It was apparently transversely ovate in shape, and was surrounded by a raised margin.

The tubercles on the anterior end of the ventral edge of the body, opposite to the branchial aperture (Pl. XLVIII. fig. 1), are the only marked processes of the test. The other smaller projections are placed chiefly along the ventral edge of the body and at the posterior end.

The branchial sac (Pl. XLVIII. fig. 2) is of the usual Culeolid structure. It is not unlike that of *Culeolus perlatus*, but the meshes are more elongated vertically in the present species. The branchial folds are fairly well-marked (Pl. XLVIII. fig. 2, *br.f.*), and the usual spicules are present in the internal longitudinal bars.

The tentacles are fairly large, but they are sparingly branched (Pl. XLVIII. fig. 4).

Subfamily 2. Cynthinæ.

In this group of the Cynthiidæ additional specimens of two previously known species of *Cynthia* have to be recorded. In the case of one of these species (*Cynthia pallida*, Heller) the new specimens extend the known geographical range of the species, and also its bathymetrical range, but in the other case (*Cynthia papietensis*, Herdman) the additional specimens are from the same locality as those previously examined.

Cynthia pallida, Heller.

Two additional specimens of this species have been sent to me for description. In the one from Station 192 the body is much flattened, the apertures are not far apart, they are sessile, but not inconspicuous. The colour is pale white, and hyaline on the edge. A little sand adheres, chiefly on the left side and the posterior end of the right side. The long convoluted yellow ovary shows through on the right side of the body. The length is 3 cm., and the breadth (dorso-ventrally) is 3·5 cm.

The test is thin and semi-transparent. It contains many spicules; some of these are large, while smaller ones are found in the vessels as in the case of *Cynthia papietensis*.[1] The mantle is rather thin, and adheres to the inner surface of the test. It is full of large fusiform spicules.

[1] See this Report, part i. p. 144, pl. xvii. fig. 14.

The branchial sac is large and very delicate. It has eight large folds upon each side, the folds being about equal in width to the interspaces. Several Crustacea were found in the branchial sac.

The endostyle is very distinct, but narrow; it is white in colour. The tentacles are compound and large. There seem to be only twelve longer tentacles, which are greatly branched, and some smaller intermediate ones.

The dorsal tubercle is placed in a deep triangular peritubercular area; it is small and ovate in form, with the longer axis vertical. The aperture is lateral.

The intestine is very long and narrow. The ovaries are in the form of a long convoluted yellow tube upon each side of the body.

One specimen of this species was obtained at Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; and a second was sent in a bottle containing no label: the locality of this specimen is consequently not known. The specimens described in the First Part of the Report were obtained from Simon's Bay, Cape of Good Hope, and Kandavu, Fiji Islands, all in shallow water, consequently the specimen from Station 192 has extended the known bathymetrical range of the species by upwards of 100 fathoms.

Since the publication of the First Part of this Report, and after the preceding description of the new specimens of *Cynthia pallida* had been drawn up, I received from Dr. C. Ph. Sluiter of Batavia, a letter giving an account, with sketches, of a variety of the species which he has since described[1] and figured under the name of *Cynthia pallida*, var. *billitonensis*. The species is evidently a variable one. Dr. Sluiter's specimens, obtained in shallow water off the Island of Billiton, in the Malay Archipelago, are of larger size than any of the Challenger specimens, and they also differ somewhat in the shape of the spicules, and in other details. The dorsal tubercle is figured by Sluiter as having symmetrically coiled horns and an anterior median aperture. In the Challenger specimen from Station 192, as I have stated above, the aperture is lateral, and therefore the tubercle is unsymmetrical. This organ is liable to great variation in some species.

Cynthia papietensis, Herdman.

Cynthia papietensis, Herdman, Report upon Challenger Tunicata, part i. p. 143, pl. xvii. figs. 10–16.

A small bottle containing three specimens of this interesting little species has reached me since the publication of the First Part of this Report. It is labelled Papieté Harbour, Tahiti, 20 fathoms, the only locality known for the species. These additional specimens do not differ in any noteworthy points from those previously examined.

[1] Ueber einige einfachen Ascidien, &c., *Natuurkund. Tijdschr. v. Nederlandsch. Indie*, Band xlv. p. 160, Batavia, 1885.

Subfamily 3. Styelinæ.

Several representatives of this group of the Cynthiidæ have to be added to those previously described. The most noteworthy are the two remarkable species *Bathyoncus discoideus* and *Bathyoncus minutus*, for the reception of which I was inclined at first to found a new genus. It is better probably to refer them provisionally to the genus *Bathyoncus*, from which, however, they may possibly have to be separated afterwards when they become better known. There is only a single specimen of each species in the collection, and that of *Bathyoncus minutus* is much damaged. This latter form was obtained from a depth of 3125 fathoms, the greatest depth at which Tunicata have yet been found. The larger species, *Bathyoncus discoideus*, is a remarkably flattened disk-like form, which was found adhering to a manganese nodule brought up from a depth of 2300 fathoms.

Bathyoncus discoideus, n. sp. (Pl. XLVII. fig. 6; Pl. XLVIII. figs. 5–11).

External Appearance.—The shape is discoidal and almost perfectly flat. It is attached by the whole of one surface, and has a slight spreading margin. The apertures are both quadrate; they are situated on the upper flattened surface, and are moderately far apart. The surface is nearly smooth. The colour is pale grey, with a slaty tinge in some places.

The diameter in a line joining the two apertures is 2·9 cm., and the diameter at right angles to that is 3·1 cm.

The Test is thin but tough. It is almost opaque on the upper surface, but quite transparent on the lower attached surface. The upper surface is slightly corrugated.

The Mantle is thin and membranous. The musculature is close but very delicate.

The Branchial Sac has several folds upon each side. The internal longitudinal bars are well developed. There may be as many as eight bars on one of the larger folds. The transverse vessels are rather narrower than the internal longitudinal bars, and are all of the same size. The meshes are large, and are slightly elongated vertically.

The Tentacles are simple, and few in number.

The Alimentary Canal is relatively of small size. It is placed on the left side of the body, and forms an open loop.

The Reproductive Organs are in the form of small rounded bodies scattered over both sides of the mantle.

Locality.—Station 241, June 23, 1875; lat. 35° 41′ N., long. 157° 42′ E.; depth, 2300 fathoms; bottom, red clay; bottom temperature, 35°·1 F.

This is one of the most remarkable of the new Simple Ascidians discovered during the Challenger Expedition. A single specimen was obtained in the North Pacific, to the

east of Japan, from a depth of 2300 fathoms. It agrees with the genus *Bathyoncus*, as characterised in the First Part of this Report, in having four-lobed apertures, simple tentacles, and a branchial sac with folds but no true stigmata. It differs, however, very greatly from *Bathyoncus mirabilis*, the type species of the genus, in the condition of the reproductive organs and in the shape of the body (see Pl. XLVIII. fig. 5); possibly it may have to be separated from *Bathyoncus* when the Deep-sea Ascidians come to be more thoroughly known.

The body in *Bathyoncus discoideus* is flattened antero-posteriorly to such an extent that the test forms merely a basal expansion attached to the surface of the manganese nodule, and an upper expansion which is very slightly curved and forms the anterior end of the body on which the branchial and atrial apertures are placed. The margin forms a slight spreading edge (Pl. XLVIII. fig. 5). The surface of the test is marked by fine concentric ridges or striæ. The apertures are distinct (Pl. XLVIII. fig. 5) but not prominent.

The test on the posterior part of the body is extremely thin, and all the inequalities of the surface of the manganese nodule are seen through it distinctly. The upper part forming the anterior surface of the body is tougher and more opaque.

The mantle has the muscle bands running in all directions (Pl. XLVIII. fig. 6), so as to form an intricate network.

The branchial sac shows the remarkable open structure first discovered in the genus *Culeolus*, and which seems to be associated with the abyssal zone. It has been found in both Simple and Compound Ascidians, but only in forms from deep water. The branchial folds are of various sizes. A small fold consists of two closely placed bars only (see Pl. XLVIII. fig. 8), while a large fold has as many as eight bars (Pl. XLVIII. fig. 9). The meshes between the folds are large (Pl. XLVIII. fig. 8). The inner edges of the internal longitudinal bars are thickened, but no cilia are present (Pl. XLVIII. figs. 8, 9, 10). A few calcareous spicules are present in the internal longitudinal bars, but they are very small and difficult to see. They are visible under a high power (see Pl. XLVIII. fig. 10). The tentacles are short and stout (Pl. XLVIII. fig. 7). The anterior edge of the tentacle is thickened.

The alimentary canal is short and of small calibre (Pl. XLVII. fig. 6). It lies on the dorsal edge of the left side of the body, behind the branchial sac. The œsophagus is short and funnel-shaped (Pl. XLVII. fig. 6). The stomach is small and globular; it is smooth-walled. The intestine curves round in a wide loop so as to reach the œsophagus, close to which it terminates, not far from the atrial aperture. The intestine, like every other part of the body, is flattened, and is about 1·5 mm. in width. It is of a light grey colour, and is thin-walled and almost transparent.

The reproductive organs are situated on both sides of the body. They are in the form of small scattered clumps, possibly modified polycarps, most of which occur upon

the left side, outside the loop of the intestine (see Pl. XLVII. fig. 6). A few also occur on the right side of the body. Each clump consists of a number of small rounded masses, united to the base of a short tubular duct (see Pl. XLVIII. fig. 11) which opens into the peribranchial cavity.

Bathyoncus minutus, n. sp. (Pl. XLVII. figs. 7–10).

External Appearance.—The shape is nearly discoid, and the body is flattened antero-posteriorly. It is attached by the entire lower surface. The margin is expanded and very thin. The apertures are placed on the upper surface, and are rather far apart. They are both of small size but distinctly visible, and are placed upon slight papillæ. They are not regularly lobed, but each aperture has a number of slight grooves radiating from it. The surface is even, but minutely roughened. The colour is dark brown.

The diameter of the body is 5 mm., and the thickness is about 0·5 mm.

The Test is stiff and somewhat brittle, but thin. It is leathery in consistence. It is of a yellowish-brown colour on the inner surface, but is darker in the neighbourhood of the apertures. The upper surface is raised into a number of small blunt projections, which are especially numerous around the apertures.

The Mantle is closely united to the inner surface of the test. It is moderately muscular. There are a number of longitudinal bands which radiate from the two apertures; these, with the circular muscle bands, form a network over the anterior part of the body (see Pl. XLVII. figs. 9, 10). The sphincters around the apertures are rather strong.

The Branchial Sac appears to have no folds. The transverse vessels and internal longitudinal bars are few in number, but wide; they form large meshes.

The Dorsal Lamina is a plain membrane.

The Tentacles are few and simple. They are of two sizes, which occur alternately.

The Alimentary Canal is short and has no complications. It forms a simple loop.

The Reproductive Organs form a single mass attached to the mantle.

Locality.—Station 253, July 14, 1875; lat. 38° 9′ N., long. 156° 25′ W.; depth, 3125 fathoms; bottom, red clay; bottom temperature, 35°·1 F.

One specimen of this small species was obtained attached to a nodule of manganese dredged in the North Pacific Ocean from the great depth of 3125 fathoms. The specimen had been detached and mounted in glycerine as a microscope slide before it came into my hands. It is almost perfectly flat now (Pl. XLVII. fig. 7), but I am inclined to think that it has been squeezed while mounting, and is really unnaturally flattened and somewhat distorted. The lower surface by which it was attached is black, and has small particles of the manganese still attached to it; the upper has the thin and irregularly expanded margins black, while the central part which, when living, was probably slightly convex, is of a brown colour. The two apertures are placed at the edges of the brown part of the

body, and are consequently about as far apart as they can possibly be (Pl. XLVII. fig. 7). They look as if they were extremely contracted, and although no traces of lobes are visible they may have been square when opened. Figures 9 and 10 on Plate XLVII. show the branchial and atrial apertures seen from the inside. When magnified about 50 diameters the brown upper surface of the test is seen to be distinctly roughened, and to consist of a yellowish ground mottled with brown and black marks. The lower surface, on the other hand, is of a dull black colour throughout. The test is particularly stiff, and seems almost horny in texture. The musculature in the mantle is well developed (Pl. XLVII. figs. 9, 10).

The branchial sac has the usual open structure with no true stigmata. The meshes are particularly large, and the vessels are wide and membranous. No cilia are visible. The endostyle is distinct; it is of a yellowish colour.

The tentacles are probably eight in number, four of them long and the other four shorter (see Pl. XLVII. fig. 9).

The œsophagus is a plain tube (Pl. XLVII. fig. 8). The stomach is globular and rather large. The intestine is short and wide; it forms a narrow loop. The stomach and intestine are of a yellowish-brown colour.

The only reproductive organs present in the single specimen are in the form of a mass of mature ova of an orange colour attached to the inner surface of the mantle.

Possibly this species, on account of the absence of folds in the branchial sac, ought to be placed in a separate genus from *Bathyoncus*, but the single specimen seems somewhat distorted, and slight folds may possibly be present, consequently I have thought it best to leave the species in the genus *Bathyoncus* for the present.

Styela radicosa (*?*), Herdman (Pl. XLIX. figs. 9, 10).

Styela radicosa, Herdman, Report upon Challenger Tunicata, part i. p. 163, pl. xxiv. figs. 6, 7.

This specimen, from Station 163, is very like the specimen described as *Styela radicosa* in the First Part of this Report (p. 163, Pl. XXIV. figs. 6, 7) in many of its characters, but does not agree perfectly in all details.

The form of the body is much the same (Pl. XLIX. fig. 9), but the posterior end is not so globular, and the root-like processes of the test are not so well marked. Also, the anterior end does not taper so much, and, as a result, the atrial aperture is placed nearer to the branchial, which is terminal in *Styela radicosa* and decidedly on the ventral edge in the present specimen. Then, again, the transverse wrinkling of the test is very slight, and not so much distributed as in *Styela radicosa*, and the colour is different. It is much darker, being creamy grey in some places and brown in others. It does not become paler towards the posterior end as in the case of *Styela radicosa*.

The length of the body is 2·2 cm., the greatest breadth is 1·5 cm., and the thickness is 0·9 cm.; hence there is considerable lateral compression.

The test is strong and tough and quite opaque. It is, however, rather thin except at the posterior end. It is white on section.

The mantle is very thick, and has imbedded in it large pale genital glands, which from their number and appearance might almost be considered as polycarps.

The branchial sac is strong. There are four folds upon each side, and they seem to vary somewhat in size, two or three being large, as in *Styela radicosa*, and the rest much slighter. The branchial sac in other characters (Pl. XLIX. fig. 10) resembles that of *Styela radicosa* (*cf.* Pl. XXIV. fig. 7, in the First Part of the Report). The internal longitudinal bars are broad and ribbon-like. The transverse vessels are all of about the same size, with the exception of the occasional much wider ones (Pl. XLIX. fig. 10, *tr.*). In some places the sac is very irregular. The figure given shows four rows of stigmata passing first into three then into two and finally into one at the edge of the fold (*br.f.*).

The tentacles are large. The branchial aperture is so much invaginated (probably through sudden and extreme contraction) as to fill up the branchial siphon and cover completely the prebranchial zone and the bases of the tentacles. The dorsal tubercle is in the same condition as in *Styela radicosa*.

In a case like the present one, where a species was described from a single specimen and then another specimen turns up afterwards which differs somewhat from the first, it is very difficult to decide whether the two should be united or considered distinct species. I think it best, taking into consideration what we know as to individual variation in Ascidians, to refer the present species to *Styela radicosa*, at least until some other specimens are found which will throw light upon the affinities of the two forms. This specimen was obtained at Station 163D, June 12, 1874, Twofold Bay, Australia; lat. 33° 57′ 30″ S., long. 151° 39′ 15″ E.; depth, 120 fathoms; bottom, green sand.

Styela pusilla, n. sp. (Pl. XLIX. figs. 7, 8).

External Appearance.—The body is dome-shaped or almost hemispherical. The posterior end forms the wide base of attachment, and has a slightly expanded margin. The anterior end is convex, and the sides are alike. The apertures are both anterior, not distant, and very inconspicuous. The surface is minutely wrinkled all over so as to give it a roughened appearance. The colour is an earthy brown.

The length of the body is 4 mm., the greatest breadth of the body is 6 mm.

The Test is moderately thick and rather tough. It is quite opaque. The inner surface is smooth, and of a bluish-white colour.

The Mantle is yellow in colour, and has the musculature well developed. It is attached to the test closely at the apertures only. The bundles of muscle fibres form a close but fine network. The sphincters are strong.

The Branchial Sac has several folds upon each side. The transverse vessels are moderately wide and all alike. The internal longitudinal bars are not very stout. The

meshes are elongated vertically, and contain each three to five stigmata, which are rather wider than the vessels between them. Muscle fibres are present in the transverse vessels.

The Tentacles are few in number but rather long.

Locality.—Station 246, July 2, 1875; lat. 36° 10′ N. long., 178° 0′ E.; depth, 2050 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·1 F.

This species, although very small, is evidently adult, since the genital gland was found to contain masses of large and mature ova. There is nothing noticeable about the external appearance (Pl. XLIX. fig. 7) of the single specimen. It might almost pass for a rather wrinkled and shabby looking individual of *Styela grossularia* of our own coasts, and yet it was obtained from a depth of over 2000 fathoms in the centre of the North Pacific Ocean.

The branchial sac (Pl. XLIX. fig. 8) is very brittle, but exhibits none of the peculiarities found in the case of some other deep-sea Ascidians. The stigmata are regular, and of the ordinary size. Cilia are present and have the usual arrangement, and no spicules are found in the vessels.

Polycarpa longisiphonica (?), Herdman (Pl. XLIX. figs. 4–6).

Polycarpa longisiphonica, Herdman, Report upon Challenger Tunicata, part i. p. 177, pl. xxiii. figs. 3–6.

This single specimen of *Polycarpa*, from Station 162, resembles *Polycarpa longisiphonica* in most particulars, but is rather different in external appearance. It is especially deficient in the characteristic from which that species derives its name, as the present specimen has the apertures sessile, though large and distinct (see Pl. XLIX. fig. 4), while in *Polycarpa longisiphonica*[1] they are placed upon the summits of singularly long projections. Then, again, the anterior extremity in this specimen is wide, while in *Polycarpa longisiphonica* it is narrow as compared with the rest of the body. The specimens of *Polycarpa longisiphonica* formerly described were either free or only very slightly attached, while the present specimen is attached to the interior of a Lamellibranch shell by a large part of its left side (Pl. XLIX. fig. 4). In the present specimen the lobes of the apertures are very much larger than those in the specimens from Port Jackson.

Notwithstanding all this external difference, the branchial sac of the present specimen (Pl. XLIX. fig. 5) is extremely like that of *Polycarpa longisiphonica*.[2] Figure 5 on Plate XLIX. shows a fold and a complete interspace formed of six rows of meshes, each more or less square in shape, and containing four to six stigmata very regularly arranged. The fold shown (*br.f.*) has nine internal longitudinal bars, the next one had eight. The transverse vessels are of three sizes (see

[1] See this Report, part i. pl. xxiii. fig. 3.

[2] See this Report, part i. pl. xxiii. fig. 4.

tr and *tr''*), usually placed alternately, as seen in the figure. No narrow horizontal membranes were noticed.

It is impossible to say with certainty whether this specimen should be described as a new species or referred to *Polycarpa longisiphonica*. I prefer to take the latter course until more specimens have been examined, and it has been determined whether or not that species has a wide range of variation.

The specimen measures 3·8 cm. in length and 2·2 cm. in greatest breadth. It was obtained at Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells.

Polycarpa bassi, n. sp. (Pl. XLIX. figs. 1–3).

External Appearance.—The body is oblong in outline, and somewhat compressed laterally. The posterior end is rounded, and the area of attachment is on its left side. The anterior end is broad and truncated, it runs obliquely forwards and ventrally. The dorsal and ventral edges are nearly straight and parallel, the body being of much the same breadth all the way down. The apertures are placed rather far apart, at the ventral and dorsal extremities of the long anterior end of the body. They are sessile and not conspicuous. The branchial is more anterior than the atrial. The surface is uneven and rough, being marked with prominent ridges and grooves, which are chiefly longitudinal, and having here and there sand grains and a few shell fragments attached. The colour is a dark ruddy brown.

The length of the body is 4·4 cm., the greatest breadth of the body is 3 cm., and the thickness is 1·8 cm.

The Test is thin but tough.

The Mantle is very thick, but the musculature is only slightly developed.

The Branchial Sac is strong and rather coarse. It is long and curved with the concavity dorsal. It has four large folds upon each side. The internal longitudinal bars are wide and ribbon-like. There are five or six upon each fold, and two or three only in the interspace. The meshes are much elongated transversely and rather irregular; each contains about twelve stigmata. The transverse vessels are all of much the same size; occasional smaller ones are present for short distances.

The Dorsal Lamina is narrow, and is a perfectly plain membrane with neither ribs nor teeth.

The Tentacles are large and simple; there are about thirty.

The Dorsal Tubercle is elliptical in outline, and is prominent though not large. It lies in a deep triangular peritubercular area, and the horns, which are turned inwards, form two closely placed spirals, each having several turns. The aperture is directed posteriorly, and the longer axis of the tubercle is transverse.

Locality.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells.

This is an ordinary *Polycarpa* with well-marked family and generic characters, but apparently distinct from any previously described species. The single specimen was obtained in Bass' Straits, from a depth of 38 fathoms. The external form (Pl. XLIX. fig. 1) is not remarkable. It has a leathery Cynthiad test corrugated and somewhat incrusted externally, and having inconspicuous apertures with no well-marked lobes. The mantle is remarkably thick (see Pl. XLIX. fig. 3), but is of a firm gelatinous consistency, and has comparatively few muscle bands.

The coarse branchial sac, although long, is rather narrow, and so leaves a considerable cloaca on the dorsal edge in which the rectum lies (Pl. XLIX. fig. 3). The transverse vessels in the branchial sac are irregular, occasionally branching or uniting. They are supplied with muscle fibres, some of which are continued into the interstigmatic vessels (Pl. XLIX. fig. 2).

The dorsal tubercle is distinctly Cynthiad in its appearance, and resembles that of *Cynthia cerebriformis*, Herdman, where, however, the aperture is lateral, not posterior. The endostyle is very prominent.

The alimentary canal is long and narrow. The œsophagus starts from the dorsal edge of the posterior end of the branchial sac, and runs almost directly ventrally, with merely a slight backward inclination, round the posterior end of the peribranchial cavity, and is attached to the inner surface of the left side of the mantle. There seems to be no marked dilatation representing the stomach (see Pl. XLIX. fig. 3), the œsophagus and intestine being directly continuous; towards the ventral edge of the posterior end the intestine turns anteriorly, then dorsally, and then somewhat posteriorly again, so as to form three-fourths of a circle. This open intestinal loop encloses a pale grey homogeneous looking soft mass (see Pl. XLIX. fig. 3), which is clearly the structure erroneously described as the ovary by Savigny in his *Cynthia mytiligera*,[1] and afterwards shown by R. Hertwig[2] to be merely a thickened fold of the lining membrane of the peribranchial space. The intestine finally runs to the dorsal edge of the body, and turns anteriorly to become the long narrow rectum, which may be traced along the dorsal edge nearly to the atrial aperture (Pl. XLIX. fig. 3). The polycarps are very numerous, and are found on both sides of the body imbedded in the mantle. Their short narrow ducts are all directed towards the atrial aperture (see Pl. XLIX. fig. 3).

This species is allied to *Polycarpa mytiligera*, Savigny,[3] but is readily distinguished from it by the external form, the absence of the stomach, and the condition of the dorsal tubercle.

[1] Mémoires, p. 98, pl. viii. fig. 2².

[2] Beiträge zur Kenntniss des Baues der Ascidien, *Jenaische Zeitschr.*, Bd. vii. p. 81.

[3] Mémoires, p. 158, pl. viii. fig. 2.

Polycarpa aspera, n. sp. (Pl. XLVII. figs. 3–5).

External Appearance.—The shape is rudely quadrate, tapering slightly towards the anterior end, and attached by the wider posterior end. The dorsal and ventral edges are slightly rounded, and the lateral compression is slight. The apertures are both placed on the anterior end, and are moderately far apart. They are projecting and conspicuous. The surface is uneven and rough. The colour is a dull opaque grey.

The length and the breadth are about 1 cm. each, and the thickness is rather less.

The Test is tough and leathery.

The Mantle is thick and opaque. The musculature is strong. There are longitudinal and transverse and also oblique muscle bands.

The Branchial Sac is large and has four well-developed folds upon each side. The internal longitudinal bars are strong and very numerous. The transverse vessels are not large. They are of two sizes, and occur the larger and the smaller alternately. The meshes are elongated vertically. The stigmata are wide; there are usually three stigmata in a mesh.

The Dorsal Lamina is a plain narrow membrane with no ribs and no teeth.

The Tentacles are simple and short. They are not numerous. There are at least two sizes which alternate with regularity. The larger tentacles are stout and rather inflated.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2.

This species is formed for a single small specimen obtained off the east coast of South America, at a depth of 600 fathoms. It is attached by the posterior end, and the test is expanded at the sides to form a spreading margin (Pl. XLVII. fig. 3). The mantle is not attached to the test. The muscle bands form a dense network.

The folds in the branchial sac are large and closely placed. There are many internal longitudinal bars upon each fold, and they are placed close together. These internal longitudinal bars may be considerably corrugated, as they are in the case of *Styela bythia* (see Part I., Pl. XVIII. fig. 6). In some places the branchial sac of this species shows irregularities. There are a great number of connectives running between the mantle and the branchial sac; some of them are very long and slender.

The tentacles are of two sizes which occur regularly, and there are also a number of intermediate very minute ones which present indications of being of a third and fourth order, and alternate regularly with those of the first and second (see Pl. XLVII. fig. 5).

The stomach is fusiform, and has its wall thrown into a large number of closely placed longitudinal folds. The intestine is long and is rather convoluted in its course. The anus has an everted lobed margin.

There are numbers of polycarps and endocarps upon both sides of the body. The polycarps are rather long and narrow. The endocarps are very numerous.

Family Ascidiidæ.

To this group belong two species, of which one (*Ciona aspera*, n. sp.) was collected during the Challenger Expedition at Japan, while the other (*Ascidia scabra* (?), O. F. Müller) was dredged during the cruise of the "Porcupine" off the coast of Ireland.

Ascidia scabra (?), O. F. Müller (Pl. XLVII. fig. 11).

One specimen, which probably belongs to this species, was obtained during the first cruise of the "Porcupine," in the summer of 1869, off the coast of Galway, at lat. 53° 10′ N. and long. 9° 19′ W., from a depth of 15 to 20 fathoms. It is about 1·5 cm. in length, and differs from typical examples of *Ascidia scabra* in having an extraordinarily long atrial siphon (Pl. XLVII. fig. 11, *at*), about 5 mm. in length. The surface of the test is smooth.

The branchial sac is in rather bad condition, and the internal longitudinal bars are very narrow. There are no papillæ. In other respects the specimen agrees fairly well with ordinary British specimens of *Ascidia scabra*.

Ciona aspera, n. sp. (Pl. XLIX. figs. 11–13).

External Appearance.—The general shape is irregularly cubical, and the body is not compressed laterally. The anterior extremity is truncated and much corrugated. The posterior end is wide and evenly rounded, there being no adhering prolongations of the test in this region. The body is attached to an Annelid tube near the middle of each side. The apertures are both anterior, being placed close together near the centre of the truncated anterior extremity; they are much contracted. The surface is very irregular, and is covered with short sharp-pointed projections, which are especially developed at the posterior end. The colour is light grey.

The length of the body is 1·5 cm., the breadth is 1·7 cm.

The Test is thin and transparent except at the points of attachment on the right and left sides, and at the anterior end where it is irregularly thickened.

The Mantle is very muscular on the anterior part of the body, and moderately so along the dorsal and ventral edges and round the posterior end. It is thin and almost destitute of muscles on the posterior parts of the two sides. The sphincters around the apertures are strong, and from under them, upon each side of the body, spring five powerful longitudinal muscle bands.

The Branchial Sac is moderately strong. The transverse vessels are all of much the same size, and are rather wide. The internal longitudinal bars are strong and bear stout papillæ at the angles of the meshes, and also intermediate ones. The latter are joined, like the chief papillæ, by delicate horizontal membranes which divide the meshes

transversely. The meshes are square or slightly elongated longitudinally, and contain four to six stigmata each.

The Dorsal Tubercle is small and circular in outline. It lies in a nearly symmetrical peritubercular area.

Locality.—Station 233A, May 19, 1875; lat. 34° 38′ N., long. 135° 1′ E.; depth, 50 fathoms; bottom, sand.

This species is closely allied to the common and widely distributed *Ciona intestinalis*. A single specimen was dredged off Kobé, Japan, from a depth of 50 fathoms, the same locality in which *Ciona savignii* was found (see Part I. p. 236).

The body, as figured and described above, is evidently greatly contracted, especially at the anterior end (Pl. XLIX. fig. 11). Probably when living and expanded in sea water it would attain twice its present length, and under these circumstances the points of attachment to the Annelid tubes, which are now nearer the anterior than the posterior end, would be probably about the junction of the middle and posterior thirds of the body. The anterior end when expanded would certainly be much narrower than at present, and probably would be represented merely by the narrow region lying between the apertures. The posterior extremity has probably changed little. The surface would, when the body became expanded, lose much of its irregularity. The anterior corrugations would certainly disappear, but the characteristic roughness due to projections of the test would of course remain. This roughening of the surface distinguishes the test very clearly from that of *Ciona intestinalis* and of *Ciona savignii*, and reminds one of the appearance presented by *Ascidia aspersa*, O. F. Müller.

When the test is removed the body presents a most characteristic appearance (Pl. XLIX. fig. 12). The anterior end is narrow and bears the two apertures. The posterior is very wide, and is evenly rounded like the posterior end of the test. The whole body is thrown into a strong curve having the convexity dorsal, but this is no doubt partially due to the state of contraction of the specimen. The siphons are prominent and the branchial is twice as wide as the atrial. The apertures are distinctly lobed, and the red ocelli are conspicuous. The sphincters surrounding the siphons are strong, and are continued posteriorly as a series of circular bands running round the anterior end of the body for a short distance below the siphons. Behind this point the circular muscles are feebly developed, and they are almost entirely absent on the middle of each side. Along the dorsal and ventral edges and round the posterior end of the body they are rather stronger and run irregularly. The longitudinal muscle bands are very powerful, and are ten in number, five on each side. They are more closely placed ventrally than dorsally, and they approach more nearly to the ventral edge than to the dorsal, the most dorsally placed band being placed near the middle of each side. These longitudinal bands make their appearance from underneath the anterior circular muscles, and run backwards,

curving ventrally as they go, and keeping within the ventral half of each side. About three-fourths of the way back they split up and become lost in the irregular fibres surrounding the posterior end of the body.

At the base of the atrial siphon a red spot is seen distinctly through the muscles of the mantle. This is the pigmented glandular mass, placed on the extremity of the vas deferens, which is sometimes so conspicuous in *Ciona intestinalis*. It has been described in that species by Heller,[1] and more recently by Roule,[2] who regards it as a renal organ.

The branchial sac is very similar to that of *Ciona intestinalis*, and possesses no noteworthy peculiarity. Occasionally, as shown in the figure (Pl. XLIX. fig. 13), one or two stigmata are interrupted where the delicate horizontal membranes connecting the intermediate papillæ cross them, but no small transverse vessels extending the length of a mesh were found.

Several Crustacea were present as commensals in this branchial sac.

[1] Untersuchungen über die Tunicaten des Adriatischen Meeres, II. Abth., *Denkschr. d. k. Akad. d. Wiss. Wien*, Bd. xxxiv. p. 120, 1875.

[2] Roule, Recherches sur les Ascidies Simples des Côtes de Provence, p. 170.

APPENDIX B.

DESCRIPTION OF A NEW SPECIES OF PSAMMAPLIDIUM.

After the greater part of this Report had been printed and the plates finished, I received from the Challenger Office a small bottle containing some sandy masses obtained on the north coast of Australia, which proved on examination to be specimens of a new species of the genus *Psammaplidium*. As it was too late to insert this species in its proper place in the body of the Report, a description of it is given here.

Psammaplidium pyriforme, n. sp.

External Appearance.—The shape of the colony is rudely pyriform. The upper end is wide and usually flattened, while the lower part tapers to a small area of attachment. The sides vary in shape, they may be convex or almost flat. The surface is irregular and rough. The colour is yellowish-grey.

The length is 2 cm., the greatest breadth is 1·3 cm., and the thickness is 1 cm.

The Ascidiozooids are not large. They are placed at right angles to the upper surface of the colony, but do not show any regular arrangement in systems. The body is elongated antero-posteriorly, and the post-abdomen is distinctly separated from the anterior part.

The Test is very stiff and hard but brittle. It is densely crowded with sand-grains and other foreign particles. The matrix is clear and transparent. The test cells are small and inconspicuous.

The Mantle is thick, and the musculature is very strong. The muscle bands run chiefly in a longitudinal direction.

The Branchial Sac is long and narrow. The stigmata are numerous. They are of fair size and are arranged regularly.

The Endostyle is large and conspicuous.

The Tentacles are numerous but rather short. They are all of one size.

The Alimentary Canal forms a narrow loop. The stomach is globular and smooth-walled.

The Post-Abdomen is long and narrow.

Locality.—Station 186, Flinder's Passage, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud.

Half a dozen specimens of this small species of *Psammaplidium* were dredged between the north end of Australia and New Guinea, from a depth of 8 fathoms. They are sandy masses of a yellowish-grey colour (the colour of the sand grains), and having a more or less pyriform shape. The upper end is always the wider, and the area of attachment is small. In some cases a short stout peduncle is present. In form this species resembles many of the specimens of *Amaroucium variabile* (see fig. 9, *c.*, on p. 217), but differs in its colour and sandy condition. The dimensions given above are those of one of the largest colonies. The smallest ones are about one-fourth of that size.

The upper end of the colony is usually flat, and is irregularly divided into areas by stiff sandy ridges. This may possibly be an indication of systems, but no common cloacal apertures were observed.

The Ascidiozooids are opaque and of a yellowish-brown colour, which is due to the mantle. They are usually 3 or 4 mm. in antero-posterior length, and from 0·5 to nearly 1 mm. in greatest breadth.

The test owes its stiffness and opacity entirely to the very large amount of imbedded sand. The matrix when seen by itself is transparent, and the test cells are not pigmented. There is fully as much sand in this test as in the case of any of the previously described species of the genus (see p. 237).

The muscle bands of the mantle are strong and closely placed. They form almost a continuous muscular investment over the whole body. Although the chief bands are longitudinal, transverse muscle fibres are present in abundance, and are placed with great regularity. The branchial and atrial siphons are well developed but not long. They are both six-lobed, and the lobes are distinct but short and rounded.

The branchial sac is rather opaque, but is well developed. The ciliated cells bounding the stigmata are distinct. The tentacles are stout and closely placed.

The long slender post-abdomen usually has its edges somewhat corrugated. Its musculature is strong, and is entirely longitudinal in direction.

The reproductive organs were not developed in any of the Ascidiozooids examined, and no larvæ were found in the colony.

This species resembles *Psammaplidium subviride* (see p. 244), from Station 142, more than it does any of the other known species of the genus. It is, however, distinctly characterised by its pyriform shape, its colour, which is not at all green, the very strong musculature of the mantle, and the comparatively short stigmata in its branchial sac. The stigmata of *Psammaplidium subviride*, on the other hand, are very long and narrow (see Pl. XXXI. fig. 6, *sg.*).

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EXPLANATION OF THE PLATES.

The figures were copied from my pencil drawings with the exception of Plates II. and VII., which I drew on stone from the specimens.

Plates I., III.–VI., VIII.–XIII., XVI., XIX., XX., XXII., XXVI., XXXII.–XXXVII., XXXIX.–XLII., and XLIX. were lithographed and printed by Dobb & Co., Liverpool; while plates XIV., XV., XVII., XVIII., XXI., XXIII.–XXV., XXVII.–XXXI., XXXVIII., and XLIII.–XLVIII. were lithographed and printed by Mr. F. Huth, Edinburgh.

It should be stated that some of the anatomical figures (*e.g.*, some of those representing the structure of the Ascidiozooids, and some of the branchial sacs) are "combination figures," formed of portions drawn from several different specimens and pieced together.

The following powers were used in drawing the figures for the plates :—

S. 1 = Swift's 1 inch objective, magnifying about 50 diameters.
S. $\frac{1}{4}$ = „ $\frac{1}{4}$ „ „ 230 „
S. $\frac{1}{6}$ = „ $\frac{1}{6}$ „ „ 330 „
Z. $\frac{1}{12}$ = Zeiss' $\frac{1}{12}$ objective (oil immersion), magnifying about 950 diameters.

LIST OF THE ABBREVIATIONS.

a.	Anus.	*br.f.*	Longitudinal folds in branchial sac.
ab, abd.	Abdomen of Ascidiozooid.	*br.l.*	Branchial lobe.
ad.	Adhering appendage.	*br.n.*	Nerves arising from branchial end of ganglion.
ap.	Appendage from body of Ascidiozooid.	*br.s.*	Branchial sac.
at.	Atrial aperture.	*b.v.*	Blood-vessel.
at.l.	Atrial languet.	*cæ.*	Cæcum of stomach.
at.n.	Nerves arising from atrial end of ganglion.	*c.d.*	Connective duct in the branchial sac.
at.tn.	Atrial tentacles.	*cl.*	Cloacal aperture.
b.c.	Blood-corpuscles.	*d.l.*	Dorsal lamina.
bl.	Bladder cells in test.	*d.t.*	Dorsal tubercle.
br.	Branchial aperture.		

ec. . . Ectoderm.
em., *emb.* Young buds.
en. . . Endostyle.
en.c. . Endocarp.
end. . Endoderm.
ep. . . Epithelium.
f.d. . . Fold in wall of stomach.
f.p. . . Foreign particle in test.
g. . . Hermaphrodite genital mass.
g.d. . Genital ducts.
gl.n. . . Subneural gland.
gm, *gm'*. . Gemmæ.
h. . . Heart.
h.m. . Horizontal membrane of branchial sac.
h.t. . . Hepatic (?) tubules.
i, *i'*. . Intestine.
l.l. . . Internal longitudinal bars of branchial sac.
inf. . Infundibulum.
l. . . Languet.
l.s. . . Lower surface of colony.
l.v. . . Fine longitudinal vessels.
m. . . Mantle.
m.b. . Muscle bands.
mes. . Mesoderm.
m.f. . Muscle fibres.
mh. . Meshes of branchial sac.
mh.n. . Narrow mesh.
mh.w. . Wide mesh.
n.g. . Nerve ganglion.
n.gl. . Subneural gland.
n.p. . Incubatory pouch.
n.t. . Neural tube.
o. . . Mature ovum.
o'. . . A young ovum.
o.d. . Oviduct.
œ . . Œsophagus.
ov. . . Ovary.
p. . . Papillæ on the internal longitudinal bars.
p'. . . Small intermediate papillæ.
p.ab., *p.abd.* Post-abdomen of Ascidiozooid.
p.br. . Peribranchial cavity.
p.c. . Pigment corpuscle.
ped. . Peduncle.
ped.c. . Cavity in the peduncle.
ped.v. . Blood-vessel in the peduncle.
pig. . Mass of pigment cells.
p.p. . Peripharyngeal band.
r. . . Rectum.
sg. . . Stigmata.
sg.c. . Stigmatic or ciliated cells.
sp., *sp'.* . Spicules.
sph. . Sphincter muscle.
st. . . Stomach.
t. . . Test.
t.c., *t.c'.* . Small cells in the test.
t.e. . . Terminal enlargement of a blood-vessel.
t.f. . . Fibres in test.
th. . . Thorax of Ascidiozooid.
t.k. . . Terminal knob on vessels.
t.m. . Matrix of test.
tn, *tn'*. . Large and small tentacles.
tr, *tr'*. . Large and small transverse vessels.
t.v. . . Spermatic vesicle.
ty. . . Typhlosole.
u.s. . . Upper surface of colony.
v. . . Blood-vessel in test.
v.ap. . Vascular appendage.
v.ap'. . Rudimentary vascular appendage.
v.ap.c. . Canal of vascular appendage.
v.d. . Vas deferens.
ves. . Vesicle of intestinal gland.
z. . . Prebranchial zone.

For 1, 2, 3, and other special symbols see the explanations of the separate plates.

PLATE I.

PLATE I.

Figs. 1–3. *Botrylloides tyreum*,[1] n. sp.
Figs. 4, 5. *Botrylloides perspicuum*, n. sp.
Figs. 6, 7. *Botrylloides perspicuum*, var. *rubicundum*, nov.
Fig. 8. *Botrylloides nigrum*, n. sp.

Fig. 1. A colony of *Botrylloides tyreum*;[1] natural size.

Fig. 2. A small part of the same colony, enlarged, to show the arrangement of the Ascidiozooids.

Fig. 3. A very small part of the same, still more enlarged, to show the structure of the anterior end of the Ascidiozooid.

Fig. 4. A colony of *Botrylloides perspicuum*; natural size.

Fig. 5. A small part of the same colony, enlarged to show the arrangement of the Ascidiozooids in a system, the common cloacal aperture, and the terminal bulbs on the vessels in the test.

Fig. 6. A colony of *Botrylloides perspicuum*, var. *rubicundum*; natural size.

Fig. 7. Another colony of the same variety; natural size.

Fig. 8. A colony of *Botrylloides nigrum*; natural size.

[1] On the plate this species is called *Botrylloides purpureum*. As that name was pre-occupied it has been changed to *Botrylloides tyreum*.

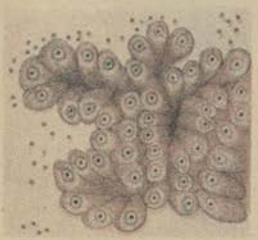


Fig. 2.

Fig. 1.

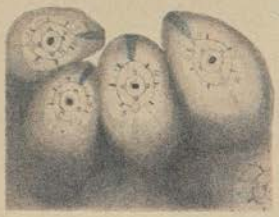


Fig. 3.

Fig. 5.

Fig. 4.

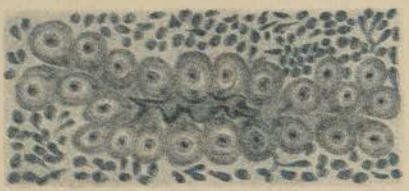


Fig. 8.

Fig. 7.

Fig. 6.

FIGs 1-3 BOTRYLLOIDES PURPUREUM, n. sp.
FIGs 4-5 BOTRYLLOIDES PERSPICUUM, n. sp.

FIGs 6-7 BOTRYLLOIDES PERSPICUUM, var. RUBICUNDUM, n.
FIG 8 BOTRYLLOIDES NIGRUM, n. sp.

PLATE II.

PLATE II.

Botrylloides tyreum,[1] n. sp.

al.n. Nerves leaving posterior end of ganglion.
b.c. Blood-corpuscle.
br. Branchial aperture.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
g. Reproductive organs.
gl.d. Duct from neural gland.
i. Intestine.
i.l. Internal longitudinal bar of branchial sac.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
m.b. Muscle band in mantle.
n.g. Nerve ganglion.
o. Ovary.
œ. Œsophagus.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
sg.c. Ciliated cells, bounding stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
tn, tn'. Tentacles.
v. Vessel in test.
z. Prebranchial zone.

Fig. 1. Part of the test showing the system of vessels and terminal knobs; magnified (S., 1 inch).

Fig. 2. A small portion of the test, more highly magnified, showing a terminal knob filled with blood-corpuscles (S., $\frac{1}{6}$ inch).

Fig. 3. Part of the mantle, showing the muscle bands, their nuclei and other details; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 4. Part of the branchial sac, seen from the inside; magnified (S., 1 inch).

Fig. 5. A small portion of the branchial sac, from the outside; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. The anterior extremity of the endostyle and neighbouring parts; magnified (S., 1 inch).

Fig. 7. An Ascidiozooid, seen from the ventral part of the right side;[2] magnified (S., 1 inch).

Fig. 8. The anterior extremity of an Ascidiozooid, seen from the inside, showing the dorsal lamina, prebranchial zone, tentacles, &c.; magnified (S., 1 inch).

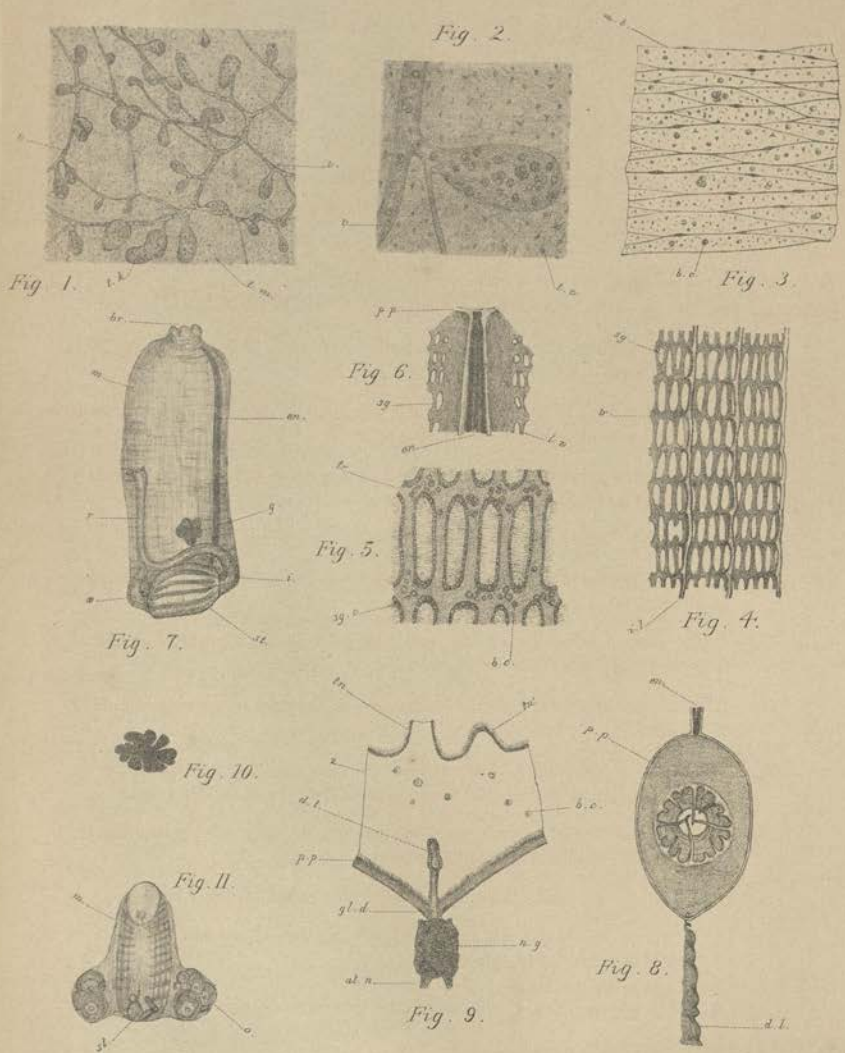
Fig. 9. The dorsal tubercle, nerve ganglion, and neighbouring parts, seen from the outside; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. The genital gland of a full grown Ascidiozooid; magnified (S., 1 inch).

Fig. 11. A young Ascidiozooid, not yet fully developed, showing the two large ovaries; highly magnified (S., $\frac{1}{6}$ inch).

[1] Named *Botrylloides purpureum* on plate.

[2] This figure was not reversed on the stone, and consequently the alimentary canal appears upon the wrong side of the branchial sac.



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BOTRYLLOIDES PURPUREUM, n. sp.

PLATE III.

PLATE III.

Figs. 1–8. *Botrylloides fulgurale*, n. sp.
Figs. 9–14. *Botrylloides perspicuum*, n. sp.
Figs. 15–18. *Botrylloides perspicuum*, var. *rubicundum*, nov.
Figs. 19–21. *Botrylloides nigrum*, n. sp.

a. Anus.
br. Branchial aperture.
br.s. Branchial sac.
cæ. Cæcum from stomach.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
ec. Ectoderm.
en. Endostyle.
gl. Glandular tubules on intestine.
i. Intestine.
i.l. Internal longitudinal bar of branchial sac.
inf. Infundibulum.
l.v. Fine longitudinal vessels of branchial sac.
m.f. Muscle fibre from mantle.
n.g. Nerve ganglion.
n.gl. Neural gland.
œ. Œsophagus.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tn. Tentacles.
tr. Transverse vessel of branchial sac.
v. Vessel in test.
z. Prebranchial zone.

Fig. 1. A colony of *Botrylloides fulgurale;* natural size.

Fig. 2. Part of the test of *Botrylloides fulgurale;* magnified (S., 1 inch).

Fig. 3. Part of the branchial sac of *Botrylloides fulgurale*, seen from the interior; magnified (S., 1 inch).

Fig. 4. Part of a vertical section through colony of *Botrylloides fulgurale*, showing the anterior part of an Ascidiozooid and the surrounding test; magnified (S., 1 inch).

Fig. 5. Surface view of anterior end of an Ascidiozooid of *Botrylloides fulgurale;* magnified (S., 1 inch).

Fig. 6. The reproductive organs of *Botrylloides fulgurale*, to show the shape; magnified (S., 1 inch).

Fig. 7. Part of the anterior end of an Ascidiozooid of *Botrylloides fulgurale*, showing the tentacles, dorsal tubercle, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. A vertical section through the anterior dorsal region of the Ascidiozooid of *Botrylloides fulgurale*, to show the relations of the nerve-ganglion, the neural gland, and the dorsal tubercle; stained in aniline blue; highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Part of a section through the test of *Botrylloides perspicuum;* magnified (S., 1 inch).

Fig. 10. A small portion of the same section, more highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. A small part of the branchial sac of *Botrylloides perspicuum;* magnified (S., 1 inch).

Fig. 12. Two pigment cells from *Botrylloides perspicuum;* highly magnified (Z., $\frac{1}{12}$).

Fig. 13. A transverse section through the endostyle of *Botrylloides perspicuum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. The alimentary canal of *Botrylloides perspicuum;* magnified (S., 1 inch).

Fig. 15. Part of the branchial sac of *Botrylloides perspicuum*, var. *rubicundum*, seen from the interior; magnified (S., 1 inch).

Fig. 16. Part of the anterior dorsal region of an Ascidiozooid of *Botrylloides perspicuum*, var. *rubicundum* showing the dorsal tubercle and neighbouring parts; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 17. The branchial sac and alimentary canal of *Botrylloides perspicuum*, var. *rubicundum;* magnified (S., 1 inch).

Fig. 18. Part of the test of *Botrylloides perspicuum*, var. *rubicundum;* magnified (S., 1 inch).

Fig. 19. Part of the branchial sac of *Botrylloides nigrum*, seen from the interior; magnified (S., 1 inch).

Fig. 20. Part of another sac of *Botrylloides nigrum*, seen from the exterior; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 21. The alimentary canal of *Botrylloides nigrum;* highly magnified (S., $\frac{1}{4}$ inch).

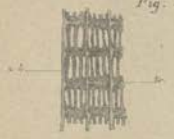

Fig. 3.

Fig. 1.

Fig. 2.

Fig. 4.

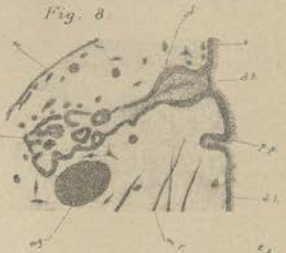

Fig. 8.

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Fig. 9.

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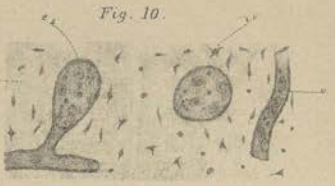

Fig. 10.

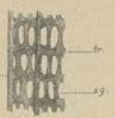

Fig. 15.

Fig. 12.

Fig. 13.

Fig. 14.

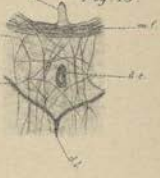

Fig. 16.

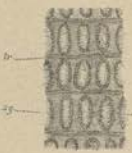

Fig. 20.

Fig. 19.

Fig. 17.

Fig. 18.

Fig. 21.

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FIGS 1-8 BOTRYLLOIDES FULGURALE, n. sp.
FIGS 9-14 BOTRYLLOIDES PERSPICUUM, n. sp.
FIGS 15-18 BOTRYLLOIDES PERSPICUUM, var. RUBICUNDUM, n.
FIGS 19-21 BOTRYLLOIDES NIGRUM, n. sp.

PLATE IV.

PLATE IV.

Figs. 1–5. *Polycyclus lamarcki*, n. sp.
Figs. 6–11. *Polycyclus jeffreysi*, n. sp.
Figs. 12–18. *Sarcobotrylloides wyvillii*, n. sp.

a. Anus.
at. Atrial aperture.
b.c. Blood-corpuscle.
br. Branchial aperture.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
ym, *ym'.* Buds in different stages of development.
i.l. Internal longitudinal bar of branchial sac.
m. Mantle.
n.g. Nerve ganglion.
œ. Œsophagus.
pig. Mass of pigmented cells.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t. Test.
t.k. Terminal bulb on vessel in test.
tn. Tentacles.
tr. Transverse vessel of branchial sac.
v. Vessel in test.
z. Prebranchial zone.

Fig. 1. Colony of *Polycyclus lamarcki;* natural size.

Fig. 2. Anterior part of Ascidiozooid of *Polycyclus lamarcki*, seen from the branchial sac; magnified (S., 1 inch).

Fig. 3. Part of the dorsal region of an Ascidiozooid of *Polycyclus lamarcki;* magnified (S., 1 inch).

Fig. 4. Surface view of the anus of *Polycyclus lamarcki;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Optical section of the anus of *Polycyclus lamarcki;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Colony of *Polycyclus jeffreysi;* natural size.

Fig. 7. An Ascidiozooid of *Polycyclus jeffreysi*, seen from the right hand side; magnified (S., 1 inch).

Fig. 8. Diagram of the vessels in the test of *Polycyclus jeffreysi;* magnified (S., 1 inch).

Fig. 9. Part of the branchial sac of *Polycyclus jeffreysi*, seen from the interior; magnified (S., 1 inch).

Fig. 10. Anterior part of an Ascidiozooid of *Polycyclus jeffreysi*, seen from the branchial sac; magnified (S., 1 inch).

Fig. 11. The atrial siphon of *Polycyclus jeffreysi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Colony of *Sarcobotrylloides wyvillii;* natural size.

Fig. 13. Vessels from the test of *Sarcobotrylloides wyvillii*, showing the contained buds; magnified (S., 1 inch).

Fig. 14. Part of the branchial sac of *Sarcobotrylloides wyvillii*, seen from the exterior; magnified (S., 1 inch).

Fig. 15. Diagram showing the arrangement of the Ascidiozooids in the test of *Sarcobotrylloides wyvillii;* magnified (S., 1 inch).

Fig. 16. Tailed larva of *Sarcobotrylloides wyvillii*, seen from the dorsal surface; magnified (S., 1 inch).

Fig. 17. Tailed larva of *Sarcobotrylloides wyvillii*, seen from the side; magnified (S., 1 inch).

Fig. 18. Portion of the tail of the larva of *Sarcobotrylloides wyvillii*, showing the large cells forming the urochord; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 1.

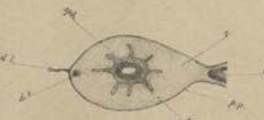


Fig. 2.

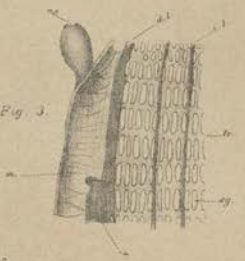


Fig. 3.

Fig. 4.

Fig. 5.

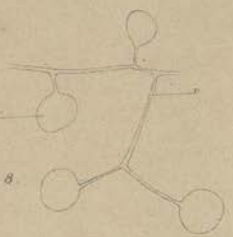


Fig. 8.

Fig. 6.

Fig. 7.

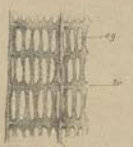


Fig. 9.

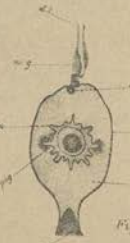


Fig. 10.

Fig. 11.

Fig. 12.

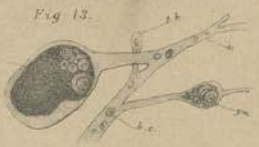


Fig. 13.

Fig. 18.

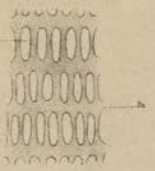


Fig. 14.

Fig. 17.

Fig. 16.

Fig. 15.

FIGS 1–5. POLYCYCLUS LAMARCKI, n sp.
FIGS 6–11. POLYCYCLUS JEFFREYSI, n sp.
FIGS 12–18. SARCOBOTRYLLOIDES WYVILLII, n sp.

PLATE V.

PLATE V.

Colella pedunculata, Quoy and Gaimard.

at. Atrial aperture.	*i.* Intestine.	*st.* Stomach.
br. Branchial aperture.	*n.p.* Incubatory pouch.	*v.ap.* Vascular appendage.
en. Endostyle.	*o.* Ovary.	

Fig. 1. Colony of *Colella pedunculata*, Quoy and Gaimard; natural size.

Fig. 2. Head of another colony of *Colella pedunculata*; natural size.

Fig. 3. Part of head of another colony of *Colella pedunculata*; natural size.

Fig. 4. Lower end of peduncle of *Colella pedunculata*; natural size.

Fig. 5. Lower end of peduncle of another colony of *Colella pedunculata*; natural size.

Fig. 6. Vertical section of head of *Colella pedunculata*; natural size.

Fig. 7. Transverse section through upper end of head of *Colella pedunculata*; natural size.

Fig. 8. Transverse section through middle of head of *Colella pedunculata*; natural size.

Fig. 9. Transverse section through lower end of head of *Colella pedunculata*; natural size.

Fig. 10. Part of the peduncle of *Colella pedunculata*; slightly enlarged.

Fig. 11. Some Ascidiozooids from the head of *Colella pedunculata*; natural size.

Fig. 12. Some incubatory pouches from the head of *Colella pedunculata*; natural size.

Fig. 13. An Ascidiozooid of *Colella pedunculata*, with the incubatory pouch, seen from the left hand side; magnified (S., 1 inch).

Fig. 14. Part of the test from the head of *Colella pedunculata*; magnified (S., 1 inch).

Fig. 15. Small part of the test from the head of *Colella pedunculata*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. Part of a section of the test of *Colella pedunculata*, from the centre of the head; magnified (S., 1 inch).

Fig. 17. Part of a section of the test of the outer part of the head of *Colella pedunculata*, showing the outer surface; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 18. Some of the large branched cells from the test of *Colella pedunculata*; highly magnified (Z., $\frac{1}{12}$).

Fig. 3.

Fig. 2.

Fig. 1.

Fig. 7.

Fig. 8.

Fig. 6.

Fig. 9.

Fig. 4.

Fig. 5.

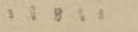


Fig. 11.

Fig. 12.

Fig. 10.

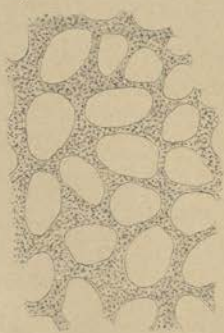
Fig. 14.

Fig. 13.

Fig. 15.

Fig. 16.

Fig. 18.



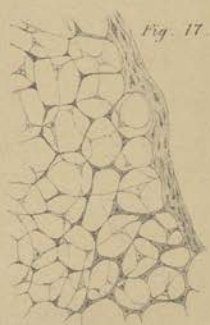


Fig. 17.

COLELLA PEDUNCULATA, Quoy and Gaimard.

PLATE VI.

PLATE VI.

Colella pedunculata, Quoy and Gaimard.

br. Branchial aperture.
en. Endostyle
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
m.b. Muscle band in mantle.
n.g. Nerve ganglion.
p.p. Peripharyngeal band.
sg. Stigmata of branchial sac.
sg.c. Ciliated cells bounding stigmata of branchial sac.
sph. Sphincter.
t. Test.
tr. Transverse vessel of branchial sac.

Fig. 1. Part of the surface layer of test of *Colella pedunculata*, showing the apertures; magnified (S., 1 inch).

Fig. 2. Part of the anterior end of an Ascidiozooid, showing the branchial siphon; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of the anterior end of an Ascidiozooid, from the left side, showing the branchial siphon in a contracted condition; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of the thorax of an Ascidiozooid, seen from the right side and ventral edge; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of the mantle of *Colella pedunculata*, showing the muscle bands, from a young Ascidiozooid; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Part of the mantle of *Colella pedunculata*, from an adult Ascidiozooid; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Part of the mantle of the incubatory pouch, showing the ectoderm; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. One of the ectoderm cells, showing the long process which runs into the test; more highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Part of the squamous epithelium lining the mantle, seen in surface view; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. Part of the branchial sac; magnified (S., 1 inch).

Fig. 11. A small part of the branchial sac; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. A small part of one of the fine longitudinal vessels of the branchial sac, showing the ciliated cells bounding the stigmata; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 13. A small part of a fine longitudinal vessel from another branchial sac, showing a different shape of ciliated cell on the stigmata; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 14. The side of one of the fine longitudinal vessels, seen from one of the stigmata; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. A transverse section of two of the fine longitudinal vessels from the branchial sac; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. Part of a branchial sac of a young Ascidiozooid; highly magnified (S., $\frac{1}{4}$ inch). D.L. indicates the dorsal and En. the ventral edge.

Fig. 17. A small part of a young branchial sac; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 18. The dorsal part of the branchial sac of a young Ascidiozooid; highly magnified (S., $\frac{1}{4}$ inch).

Fig 1.

Fig 2.

Fig 3.

Fig 5.

Fig 4.

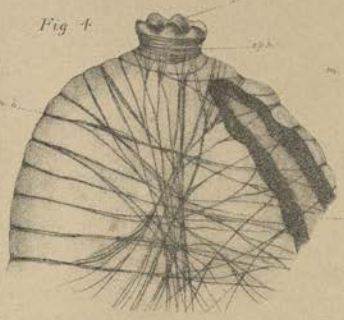


Fig 6.

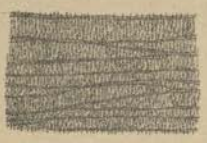


Fig 7.

Fig 10.

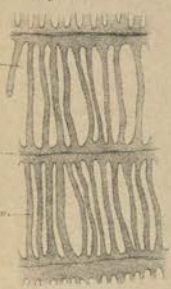


Fig 11.

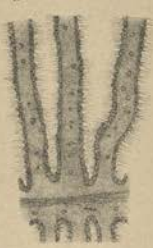


Fig 9.

Fig 8.

Fig 12.

Fig 13.

Fig 14.

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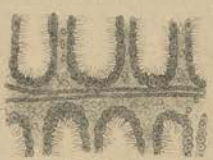
Fig 17.



D L.

En.

Fig 16.

Fig 18.

COLELLA PEDUNCULATA, Quoy and Gaimard.

PLATE VII.

PLATE VII.

Colella pedunculata, Quoy and Gaimard.

Fig. 1. Section through the test, mantle, and endostyle of an Ascidiozooid; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2. The anterior end of an Ascidiozooid, seen from the branchial sac; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. One of the dorsal languets, seen from the side; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of one of the tentacles; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. The nerve ganglion; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. The anterior dorsal region of an Ascidiozooid, showing the dorsal tubercle, tentacles, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of an Ascidiozooid from the right hand side, showing the reproductive organs and incubatory pouch; magnified (S., 1 inch).

Fig. 8. Part of the intestine and the ovary; magnified (S., 1 inch).

Fig. 9. Part of the reproductive organs; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Young ova; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Mature ovum; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 12. Young incubatory pouch with two embryos; magnified (S., 1 inch).

Fig. 13. Older incubatory pouch with a number of embryos and larvæ; magnified (S., 1 inch).

Fig. 14. Fully developed incubatory pouch, with contained embryos and larvæ; magnified (S., 1 inch).

Fig. 3.

Fig. 2.

Fig. 1.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 9.

Fig. 10.

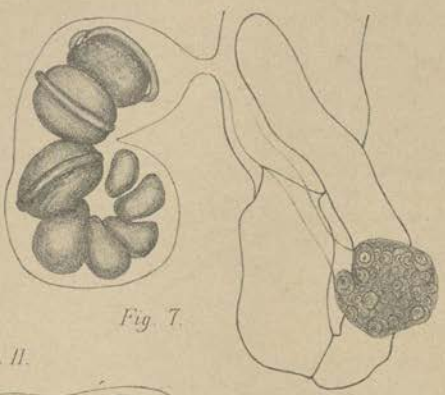


Fig. 7.

Fig. 11.

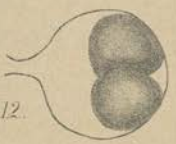


Fig. 12.

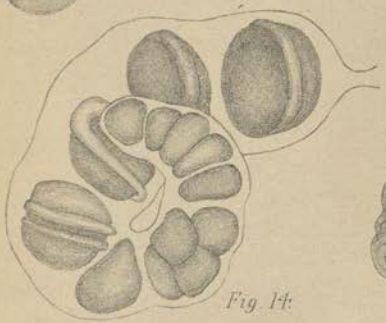


Fig. 14.

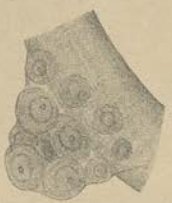


Fig. 8.

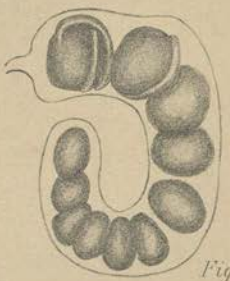


Fig. 13.

COLELLA PEDUNCULATA, Quoy and Gaimard.

PLATE VIII.

PLATE VIII.

Colella pedunculata, Quoy and Gaimard.

bl. Bladder cell. *emb.* A bud. | *o.s.* Outer surface of the test. *t.m.* Test matrix. | *v.ap.* Vascular appendage.

Fig. 1. Part of the peduncle; slightly enlarged.

Fig. 2. Transverse sections near the lower end of the peduncle; natural size.

Fig. 3. Transverse sections from the middle of the peduncle; natural size.

Fig. 4. Transverse sections from another peduncle; natural size.

Fig. 5. Transverse sections from the upper end of the peduncle; natural size.

Fig. 6. A transverse section from the lower end of the peduncle (fig. 2), showing a young bud; magnified (S., 1 inch).

Fig. 7. A transverse section from further up the peduncle (fig. 3), showing several buds; magnified (S., 1 inch).

Fig. 8. Part of a transverse section through the upper end of a peduncle, showing a number of buds; highly magnified (S., $\frac{1}{4}$ inch).

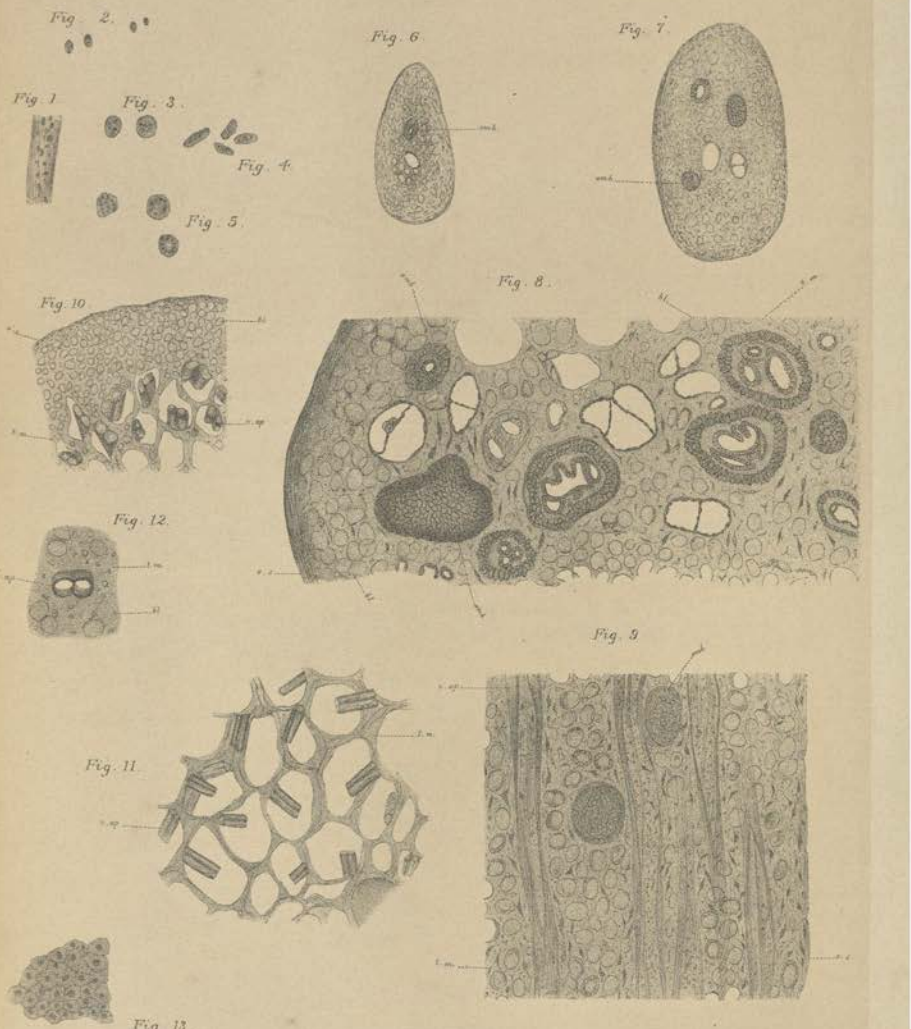
Fig. 9. Part of a longitudinal section through the peduncle, showing the vascular appendages and buds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Part of a transverse section through the upper end of the peduncle, showing the vascular appendages; magnified (S., 1 inch).

Fig. 11. Part of a transverse section through the base of the head, showing the vascular appendages and their canals; magnified (S., 1 inch).

Fig. 12. Part of a transverse section of the peduncle, showing a vascular appendage imbedded in the test; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. The ectoderm covering a vascular appendage; highly magnified (S., $\frac{1}{8}$ inch).



W.A. Henderson del. T. Dodd & Co. Lith. Lpool.

COLELLA PEDUNCULATA, Quoy and Gaimard.

PLATE IX.

PLATE IX.

Colella pedunculata, Quoy and Gaimard.

bl. Bladder cells.	*n.g.* Nerve ganglion.	*t.m.* Test matrix.
br. Branchial aperture.	*n.t.* Neural canal.	*tr.* Transverse vessel of branchial sac.
br.s. Branchial sac.	*o.* Ovary.	*v.* Vessel in test.
ec. Ectoderm.	*p.br.* Peribranchial cavity.	*v.ap.* Vascular appendage.
i. Intestine.	*sg.* Stigmata of branchial sac.	*v.ap.c.* The canal of the vascular appendage.
emb. A bud.	*st.* Stomach.	
en. Endostyle.	*t.c.* Test cells.	

Fig. 1. Transverse section through part of peduncle, showing the structure of the test and the vascular appendages; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2. Part of a transverse section, showing the cavities of vascular appendages containing proliferating blood-corpuscles; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of a longitudinal section, showing a young bud projecting from a vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of a transverse section, showing a young bud emerging from a vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of a longitudinal section, showing a young bud lying in the test alongside a vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Part of a longitudinal section, showing a young bud just becoming separated from the vascular appendage; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Transverse section of a young bud, showing the division of the archenteron; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Transverse section of an older bud, showing the branchial sac, peribranchial cavities, neural canal, &c.; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Longitudinal section of an advanced bud; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. Longitudinal section of a younger bud; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 11. Part of an advanced bud, showing the interior of the branchial sac with stigmata; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Longitudinal section of a very advanced bud or young Ascidiozooid, showing all the important organs; highly magnified (S., $\frac{1}{4}$ inch).

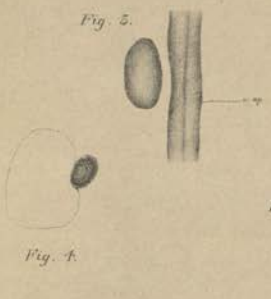


Fig. 5.

Fig. 4.

Fig. 3.

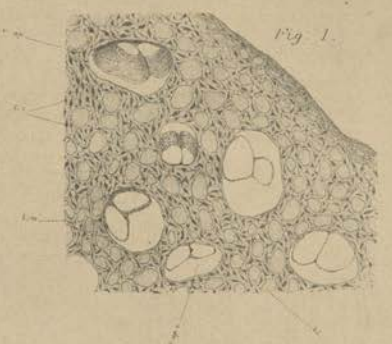


Fig. 1.

Fig. 2.

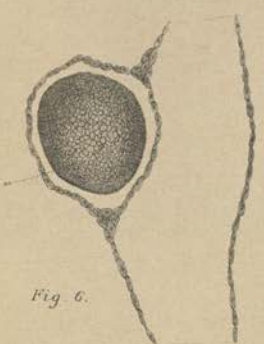


Fig. 6.

Fig. 7.

Fig. 9.

Fig. 10.

Fig. 8.

Fig. 11.

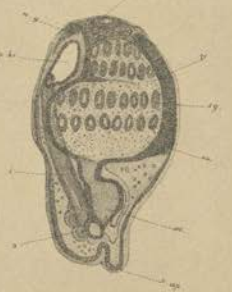


Fig. 12.

COLELLA PEDUNCULATA, Quoy and Gaimard.

PLATE X.

PLATE X.

Colella thomsoni, n. sp.

Fig. 1. Colony of *Colella thomsoni*; natural size.

Fig. 2. Upper end of colony of *Colella thomsoni*; natural size.

Fig. 3. Peduncle and lower end of head of *Colella thomsoni*; natural size.

Fig. 4. Surface view of upper end of head of *Colella thomsoni*; natural size.

Fig. 5. Transverse section through head of *Colella thomsoni*; natural size.

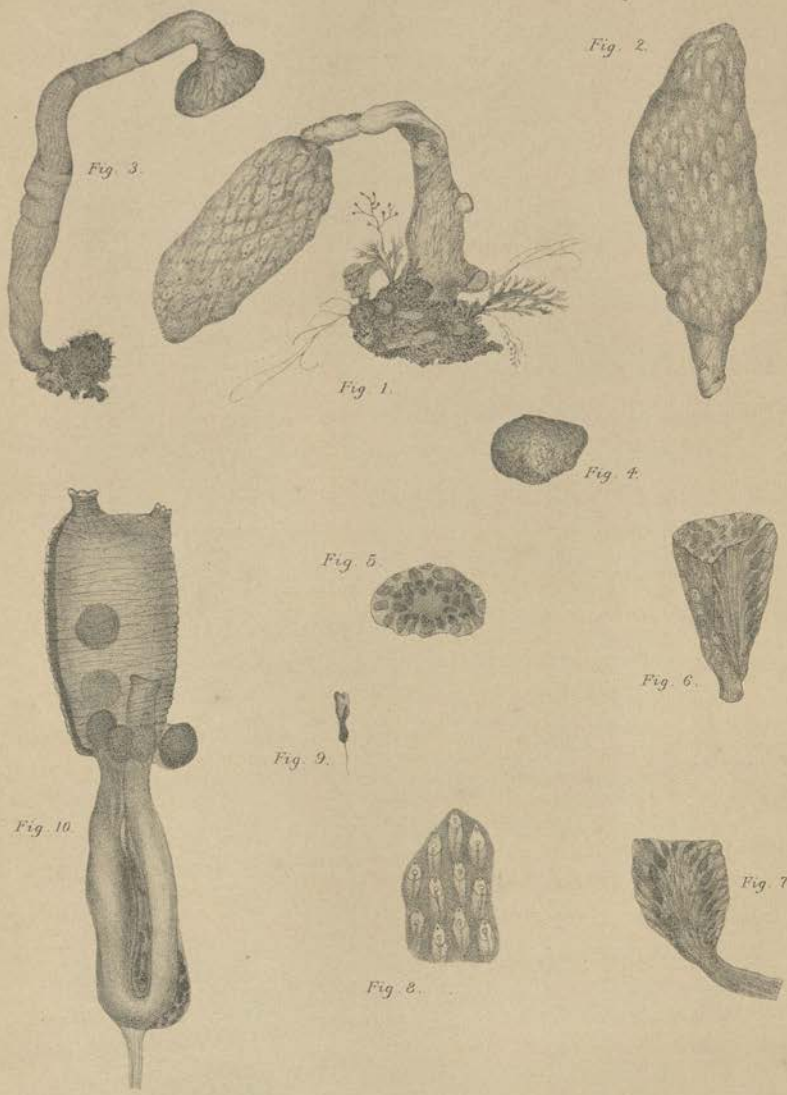
Fig. 6. Dissection of head of *Colella thomsoni*, to show arrangement of Ascidiozooids; natural size.

Fig. 7. Vertical section of lower part of head and upper part of peduncle; natural size.

Fig. 8. Part of the surface of the head; enlarged.

Fig. 9. An Ascidiozooid dissected out from the head of *Colella thomsoni*; natural size.

Fig. 10. The Ascidiozooid of *Colella thomsoni*, seen from the left hand side; magnified (S., 1 inch).



H. A. Hardman del.

T. Dobb & Co. Lith. Lyon

COLELLA THOMSONI, n. sp.

PLATE XI.

PLATE XI.

Colella thomsoni, n. sp.

emb. A bud.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
l. Dorsal languet.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
m.b. Muscle band in mantle.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.

Fig. 1. Section through the test of *Colella thomsoni;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2. Part of the body of the Ascidiozooid, seen from the right hand side; magnified (S., 1 inch).

Fig. 3. Part of the mantle and endostyle, showing the arrangement of the muscle bands; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Surface view of the ectoderm of *Colella thomsoni;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Part of the branchial sac; highly magnified (S., $\frac{1}{4}$ inch).

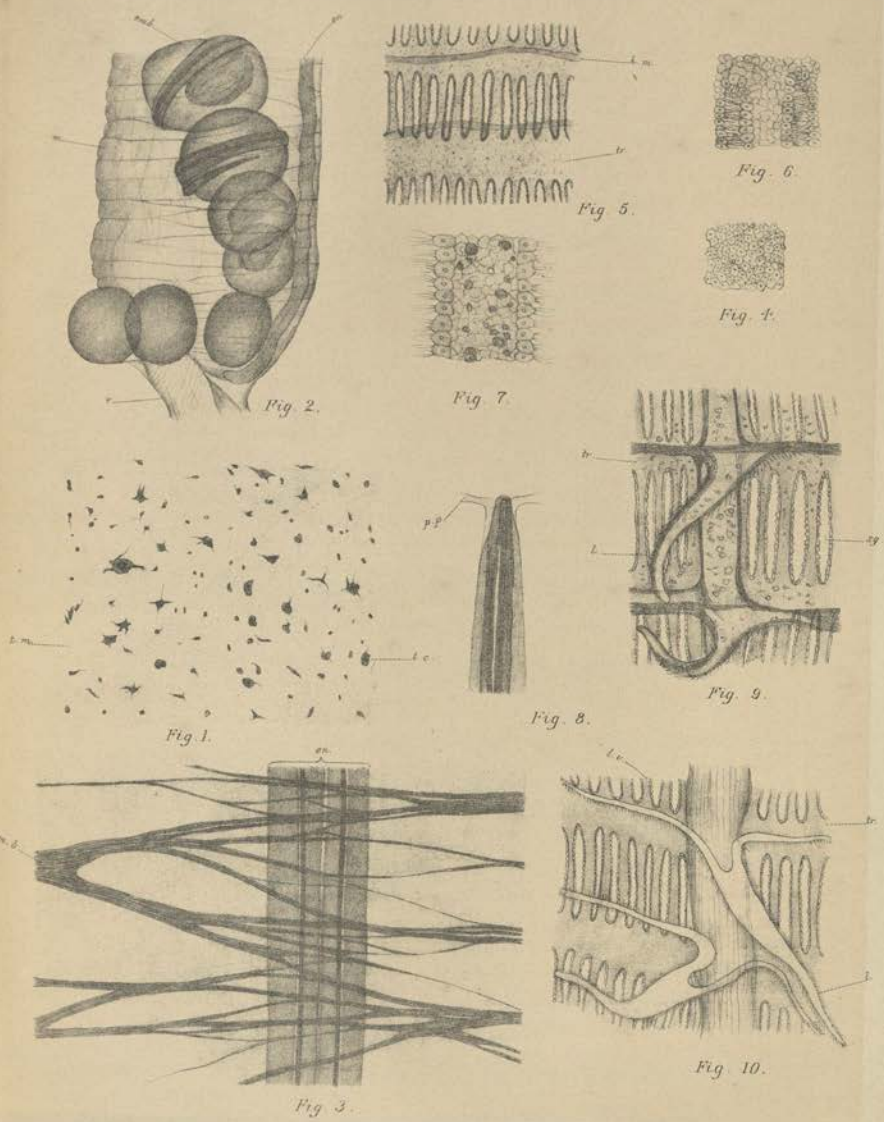
Fig. 6. A small portion of the branchial sac; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Another small portion of the branchial sac; still more highly magnified (S., $\frac{1}{6}$ inch, enlarged).

Fig. 8. The anterior part of the endostyle; magnified (S., 1 inch).

Fig. 9. Part of the dorsal region of the branchial sac, showing two of the languets; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. The same region in another specimen, showing the languets; highly magnified (S., $\frac{1}{4}$ inch).



W. A. Hardman del.

T. Dobb & Co. Lith. Lyon.

COLELLA THOMSONI. n. sp.

PLATE XII.

PLATE XII.

Colella thomsoni, n. sp.

Fig. 1. The anterior end of an Ascidiozooid, seen from the interior; magnified (S., 1 inch).

Fig. 2. The anterior end of an Ascidiozooid, showing the branchial aperture, tentacles, &c., seen from the interior; magnified (S., 1 inch).

Fig. 3. The anterior end of an Ascidiozooid, seen from the exterior; magnified (S., 1 inch).

Fig. 4. The alimentary canal; magnified (S., 1 inch, enlarged).

Fig. 5. A transverse section across the abdomen of the Ascidiozooid; magnified (S., 1 inch, enlarged).

Fig. 6. The abdomen of an Ascidiozooid, showing the alimentary canal and reproductive organs; magnified (S., 1 inch, enlarged).

Fig. 7. The male reproductive system of an Ascidiozooid; magnified (S., 1 inch, enlarged).

Fig. 8. A transverse section across the abdomen of a young Ascidiozooid, showing the ovary; magnified (S., 1 inch).

Fig. 1.

Fig. 2.

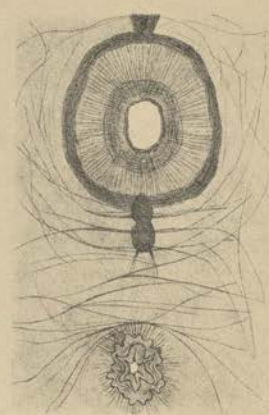


Fig. 3.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 4.

Fig. 8.

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COLELLA THOMSONI. n. sp.

PLATE XIII.

PLATE XIII.

Colella thomsoni, n. sp.

b.c. Blood-corpuscle.	*i.* Intestine.	*r.* Rectum.
br.s. Branchial sac.	*o.* Ovary.	*st.* Stomach.
ec. Ectoderm.	*œ.* Œsophagus.	*t.* Test.
en. Endostyle.	*ov.* Ova.	*t.v.* Spermatic vesicles.
gm, gm'. Buds.	*p.br.* Peribranchial cavity.	*v.* Vessel in test.
h.gl. Glandular tubules on intestine.		

Fig. 1. Part of a transverse section through the peduncle, showing the system of ramified vessels; magnified (S., 1 inch).

Fig. 2. A small part of another section; magnified (S., 1 inch).

Fig. 3. A small part of another section; magnified (S., 1 inch).

Fig. 4. Part of another section; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of the wall of one of the vessels from the peduncle; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Some of the ectoderm cells from a vessel; still more highly magnified (Z., $\frac{1}{12}$).

Fig. 7. Part of a section, from the upper part of the peduncle, showing young buds; magnified (S., 1 inch).

Fig. 8. Part of a section from still further up the peduncle, showing more advanced buds still connected with the vessels; magnified (S., 1 inch).

Fig. 9. The end of a diverticulum, from one of the vessels of the test, showing the commencement of the formation of a bud; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Longitudinal section of a very advanced bud or young Ascidiozooid (1 mm. in length), showing all the important organs of the body highly magnified (S., $\frac{1}{4}$ inch).

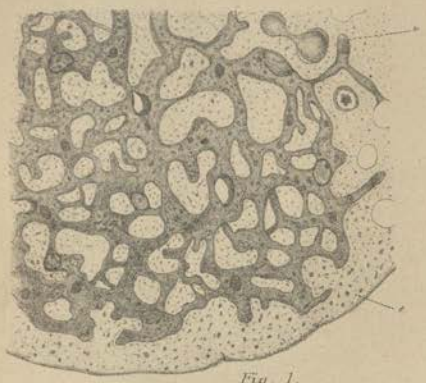

Fig. 1.

Fig. 4.

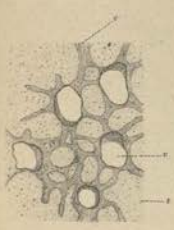

Fig. 2.

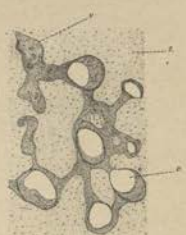

Fig. 3.

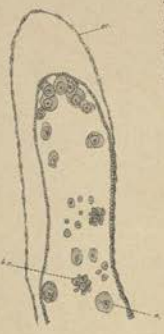

Fig. 9.

Fig. 5.

Fig. 6.

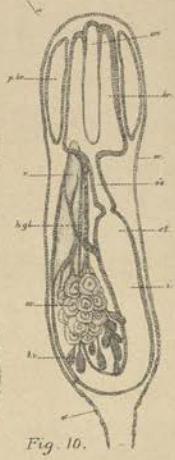

Fig. 10.

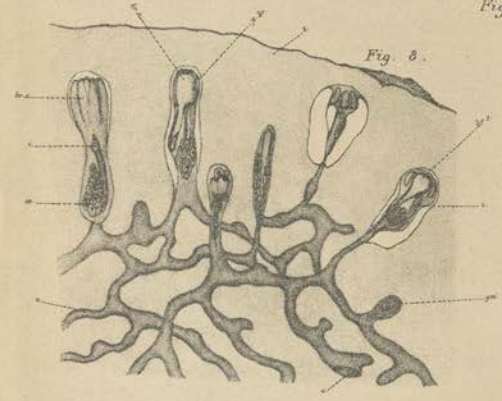

Fig. 8.

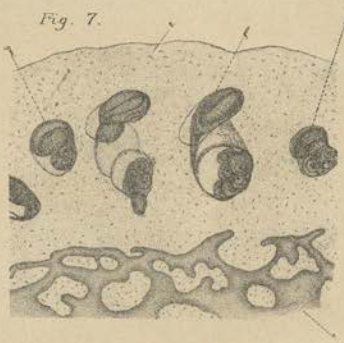

Fig. 7.

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COLELLA THOMSONI. n. sp.

PLATE XIV.

PLATE XIV.

Figs. 1–6. *Colella quoyi*, n. sp.
Figs. 7–14. *Colella gaimardi*, n. sp.
Figs. 15–23. *Polyclinum fungosum*, n. sp.

a. Anus.
at. Atrial aperture.
br. Branchial aperture.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
g. Reproductive organs.
i. Intestine.
l. Dorsal languet.
l.v. Fine longitudinal vessels of branchial sac.
m.b. Muscle band in mantle.
n.g. Nerve ganglion.
o. Ovary.
œ. Œsophagus.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.m. Test matrix.
tn, tn'. Tentacles.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of *Colella quoyi;* natural size.

Fig. 2. Another colony of *Colella quoyi;* natural size.

Fig. 3. Part of the branchial sac of *Colella quoyi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of the mantle of *Colella quoyi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. The Ascidiozooid of *Colella quoyi*, seen from the left side; magnified (S., 1 inch).

Fig. 6. Part of the alimentary canal of another Ascidiozooid of *Colella quoyi;* magnified (S., 1 inch).

Fig. 7. Colony of *Colella gaimardi;* natural size.

Fig. 8. Part of the branchial sac of *Colella gaimardi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Part of the test of *Colella gaimardi;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. The incubatory pouch of *Colella gaimardi;* magnified (S., 1 inch).

Fig. 11. Part of the dorsal region of the branchial sac of *Colella gaimardi*, showing languets; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. The abdomen of a young Ascidiozooid of *Colella gaimardi;* magnified (S., 1 inch).

Fig. 13. Part of the alimentary canal of *Colella gaimardi;* magnified (S., 1 inch).

Fig. 14. The tailed larva of *Colella gaimardi;* magnified (S., 1 inch).

Fig. 15. Colony of *Polyclinum fungosum*, seen from the upper surface; natural size.

Fig. 16. Colony of *Polyclinum fungosum*, seen from the side; natural size.

Fig. 17. Vertical section through part of the colony of *Polyclinum fungosum;* natural size.

Fig. 18. Part of the branchial sac of *Polyclinum fungosum;* highly magnified (S., $\frac{1}{4}$ inch).

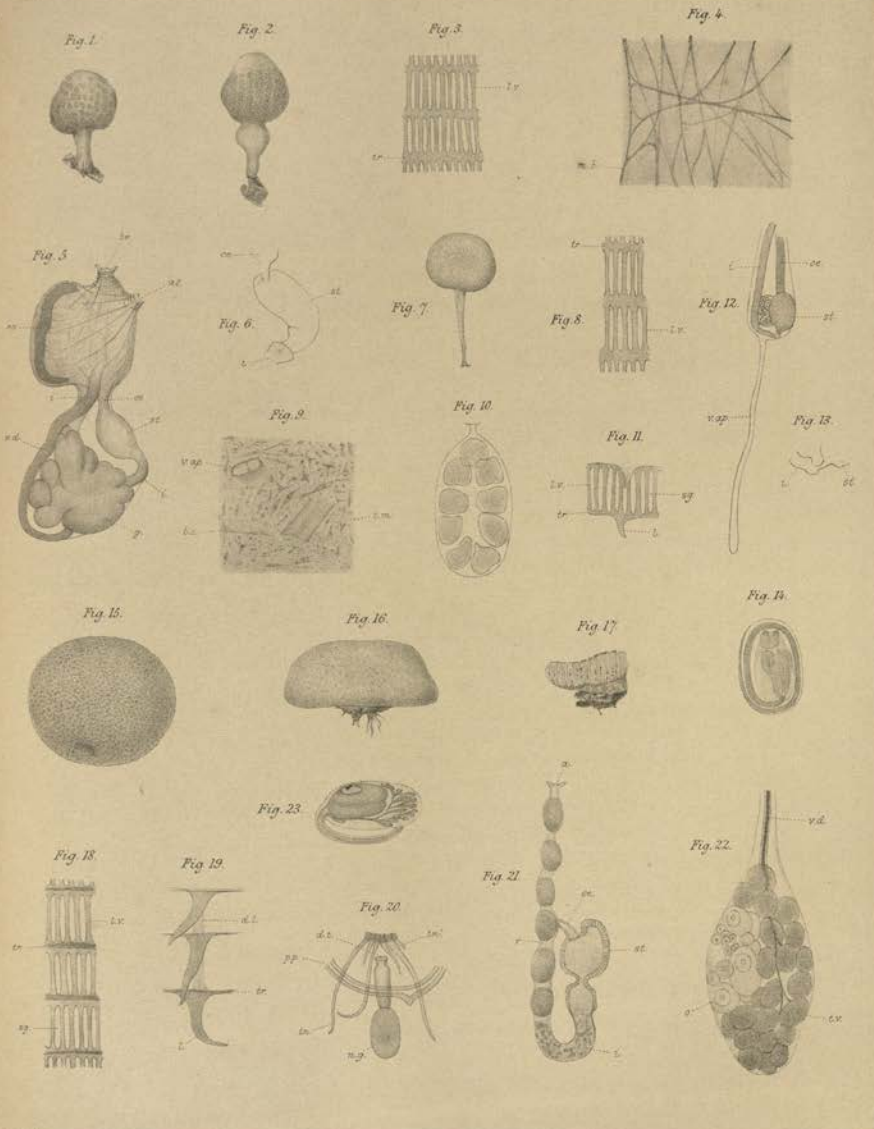
Fig. 19. The dorsal languets of *Polyclinum fungosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 20. The dorsal edge of the anterior end of the Ascidiozooid of *Polyclinum fungosum*, showing tentacles, dorsal tubercle, nerve ganglion, &c.; highly magnified (S., $\frac{1}{8}$ inch).

Fig. 21. The alimentary canal of *Polyclinum fungosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 22. The reproductive organs of *Polyclinum fungosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 23. Tailed larva of *Polyclinum fungosum*, seen from the side; magnified (S., 1 inch).



FIGS 1-6, COLELLA QUOYI, n. sp. FIGS 7-14, COLELLA GAIMARDI, n. sp.
FIGS 15-23, POLYCLINUM FUNGOSUM, n. sp.

PLATE XV.

PLATE XV.

Figs. 1–13. *Colella pulchra*, n. sp.
Figs. 14–17. *Colella ramulosa*, n. sp.

a. Anus.
ap. Appendage from the abdomen of the Ascidiozooid.
ap. Atrial aperture.
bl. Bladder cell.
br. Branchial aperture.
br.si. Branchial siphon.
c.m. Mass of cells of a nervous nature(?)
d.l. Dorsal lamina.
em. Bud.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l. Dorsal languet.
l.v. Fine longitudinal vessels of branchial sac.
œ. Œsophagus.
ot. Pigmented sense organ.
ov. Ovary.
p.c. Pigment cells.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t. Test.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessels of branchial sac.
t.v. Spermatic vesicles.
u. Urochord.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of *Colella pulchra;* natural size.

Fig. 2. Young colony of *Colella pulchra;* natural size.

Fig. 3. Part of branchial sac of *Colella pulchra;* magnified (S., 1 inch).

Fig. 4. Ciliated cells from stigmata of *Colella pulchra;* highly magnified (Z., $\frac{1}{12}$).

Fig. 5. Part of branchial sac and dorsal lamina of young Ascidiozooid of *Colella pulchra;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Part of the surface of the colony of *Colella pulchra,* showing arrangement of Ascidiozooids; magnified (S., 1 inch).

Fig. 7. Ascidiozooid of *Colella pulchra,* seen from left side; magnified (S., 1 inch).

Fig. 8. Pigmented appendage from region over stomach of Ascidiozooid of *Colella pulchra;* highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Part of peduncle of *Colella pulchra;* magnified (S., 1 inch).

Fig. 10. Transverse section of peduncle of *Colella pulchra;* magnified (S., 1 inch).

Fig. 11. Part of a transverse section through the peduncle of *Colella pulchra;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 12. Tailed larva of *Coleila pulchra;* magnified (S., 1 inch, enlarged).

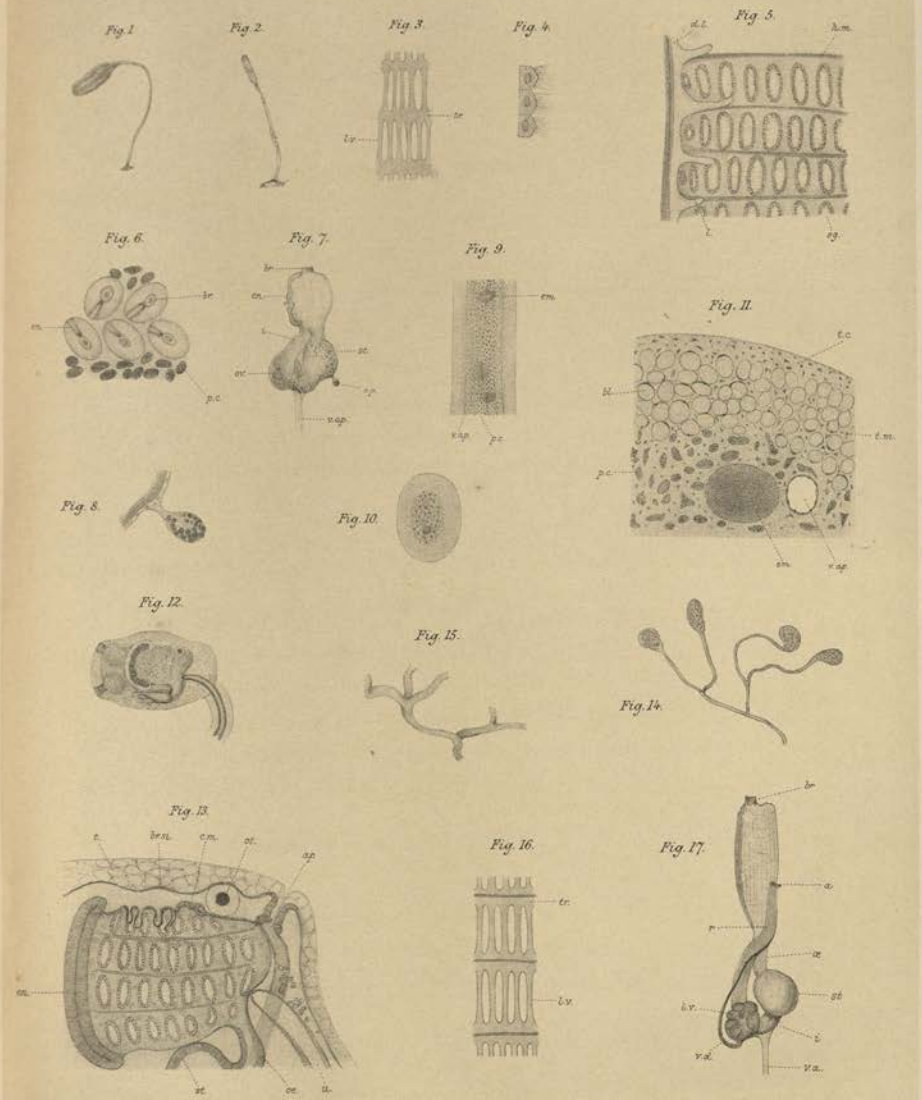
Fig. 13. Part of tailed larva of *Colella pulchra;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 14. Colony of *Colella ramulosa;* natural size.

Fig. 15. Branched peduncle of another colony of *Colella ramulosa;* natural size.

Fig. 16. Part of the branchial sac of *Colella ramulosa;* magnified (S., 1 inch).

Fig. 17. The Ascidiozooid of *Colella ramulosa,* seen from the left hand side; magnified (S., 1 inch).



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F. Huth, Lith^r Edin^r

FIG^S 1-13, COLELLA PULCHRA, n. sp. FIG^S 14-17, COLELLA RAMULOSA, n. sp.

PLATE XVI.

PLATE XVI.

Figs. 1–7. *Colella elongata*, n. sp.
Figs. 8–16. *Colella concreta*, n. sp.
Fig. 17. ——— (?) *pyriformis*, n. sp.

abd. Abdomen of Ascidiozooid.
at. Atrial aperture.
br. Branchial aperture.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
fd. Fold in wall of stomach.
gr. Groove between folds.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l. Dorsal languet.
ov. Ova.
p.p. Peripharyngeal band.
r. Rectum.
sph. Sphincter.
st. Stomach.
t. Test.
th. Thorax of Ascidiozooid.
tn, tn'. Tentacles.
t.v. Spermatic vesicles.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of *Colella elongata;* natural size.

Fig. 2. Transverse section of colony of *Colella elongata;* natural size.

Fig. 3. Part of a transverse section of *Colella elongata;* magnified (S., 1 inch).

Fig. 4. Part of the test from the centre of the head of *Colella elongata*, showing the vascular appendages; magnified (S., 1 inch).

Fig. 5. An Ascidiozooid of *Colella elongata*, seen from the right hand side; magnified (S., 1 inch).

Fig. 6. Part of a young Ascidiozooid of *Colella elongata*, showing the alimentary canal; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of the circle of tentacles of *Colella elongata;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Large colony of *Colella concreta;* natural size.

Fig. 9. Ascidiozooid of *Colella concreta*, seen from left hand side; enlarged.

Fig. 10. Part of the vascular appendage of *Colella elongata;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Ascidiozooid of *Colella concreta*, from left hand side; magnified (S., 1 inch).

Fig. 12. Part of mantle of *Colella concreta;* magnified (S., 1 inch, enlarged).

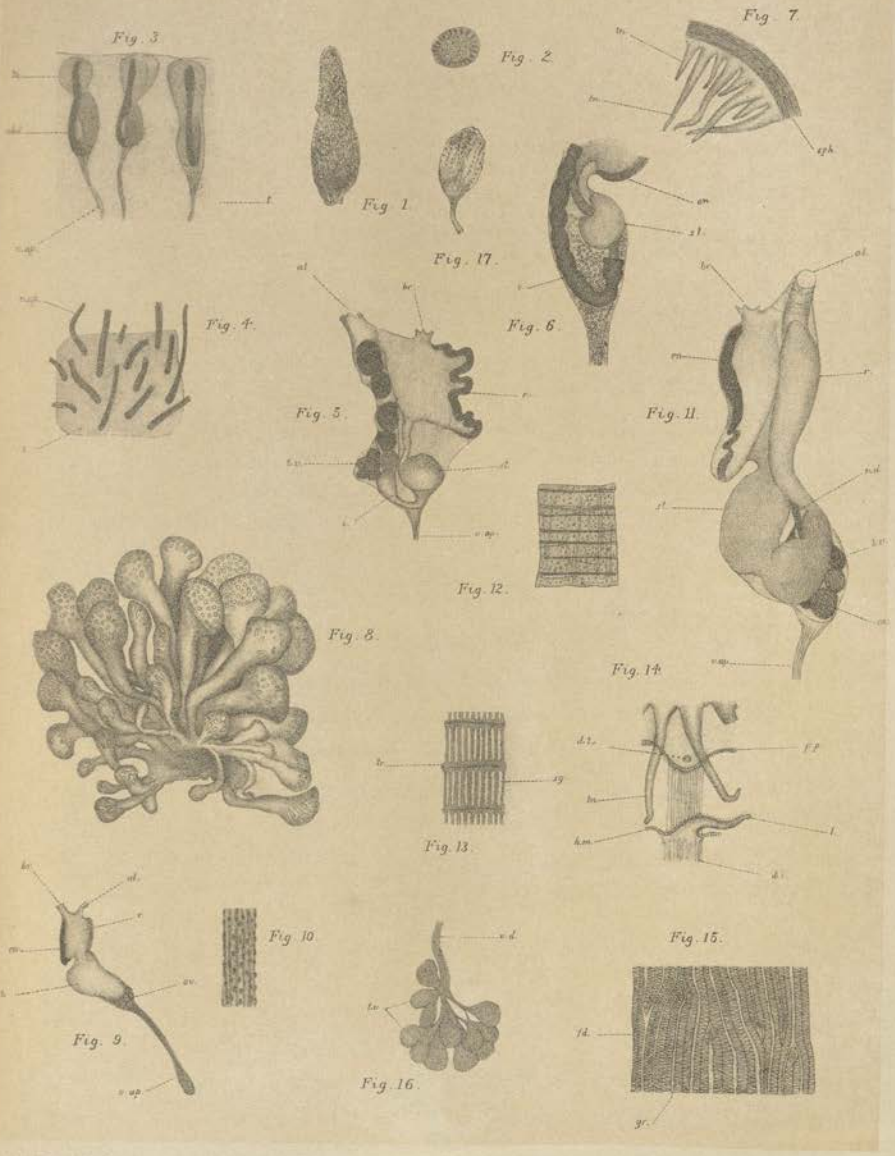
Fig. 13. Part of branchial sac of *Colella concreta;* magnified (S., 1 inch, enlarged).

Fig. 14. Dorsal part of anterior end of Ascidiozooid of *Colella concreta*, showing tentacles, dorsal tubercle, languets, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Part of wall of stomach of *Colella concreta*, spread out and seen from inside to show the closely placed longitudinal folds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. The male reproductive organs of *Colella concreta*; magnified (S., 1 inch).

Fig. 17. Colony of ——— (?) *pyriformis;* natural size.



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FIGS. 1-7, COLELLA ELONGATA, n. sp.
FIGS. 8-16, COLELLA CONCRETA, n. sp.
FIG. 17, ———— ? PYRIFORMIS. n. sp.

PLATE XVII.

PLATE XVII.

Figs. 1–11. *Colella murrayi*, n. sp.
Figs. 12–14. *Colella murrayi*, var. *rubida*, nov.

at. Atrial aperture.
bl. Bladder cell.
br. Branchial aperture.
en. Endostyle.
g. Reproductive organs.
i. Intestine.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
œ. Œsophagus.
p.c. Mass of pigment cells.
r. Rectum.
sg.c. Ciliated cells bounding stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
tn, tn'. Tentacles.
t.v. Spermatic vesicles.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of *Colella murrayi;* natural size.

Fig. 2. Upper end of colony of *Colella murrayi;* slightly enlarged.

Fig. 3. Part of branchial sac of *Colella murrayi;* magnified (S., 1 inch).

Fig. 4. Part of surface of *Colella murrayi*, to show arrangement of pigment masses; magnified (S., 1 inch).

Fig. 5. Part of transverse section of peduncle of *Colella murrayi;* magnified (S., 1 inch).

Fig. 6. The outer part of a transverse section through the peduncle of *Colella murrayi;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. The central part of a transverse section of the peduncle of *Colella murrayi;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 8. Part of transverse section of outer part of head of *Colella murrayi*, showing arrangement of Ascidiozooids and pigment masses; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Ascidiozooid of *Colella murrayi*, seen from left side; magnified (S., 1 inch).

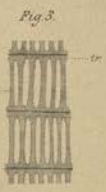
Fig. 10. Transverse section of abdomen of Ascidiozooid of *Colella murrayi;* magnified (S., 1 inch).

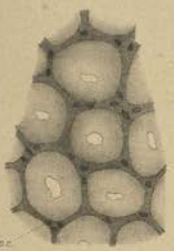
Fig. 11. Part of male reproductive organs of *Colella murrayi;* highly magnified (S., $\frac{1}{4}$ inch).

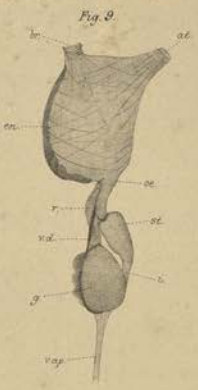
Fig. 12. Colony of *Colella murrayi*, var. *rubida;* natural size.

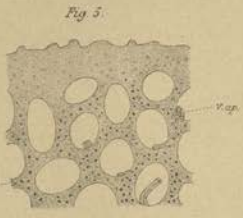
Fig. 13. Part of circle of tentacles of *Colella murrayi*, var. *rubida;* highly magnified (S., $\frac{1}{4}$ inch).

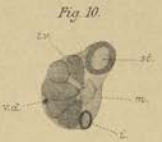
Fig. 14. Part of branchial sac of *Colella murrayi*, var. *rubida;* highly magnified (S., $\frac{1}{6}$ inch).

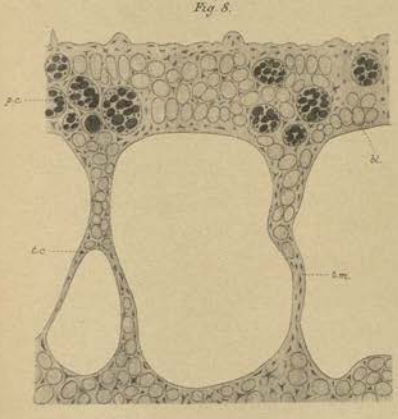


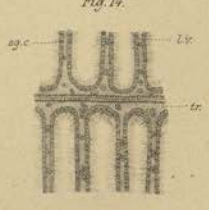












W. A. Rawson, del. F. Bedo, Lith. Edinr.

FIGS 1-11, COLELLA MURRAYI, n. sp. FIGS 12-14, COLELLA MURRAYI, var. RUBIDA, nov.

PLATE XVIII.

PLATE XVIII.

Figs. 1–6. *Distaplia vallii*, n. sp.
Figs. 7–14. *Symplegma viride*, n. sp.

at. Atrial aperture.
br. Branchial aperture.
b.p.c. Black pigment cell.
cæ. Cæcum.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
i. Intestine.
i.l. Internal longitudinal bar of branchial sac.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
œ. Œsophagus.
p.c. Mass of pigment cells.
p.p. Peripharyngeal band.
r. Rectum.
r.p.c. Red pigment cell
sg. Stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
v. Vessel in test.
v.ap. Vascular appendage.
z. Prebranchial zone.

Fig. 1. Colony of *Distaplia vallii*, from Station 212; natural size.

Fig. 2. Colony of *Distaplia vallii*, from Mediterranean; natural size.

Fig. 3. Ascidiozooid of *Distaplia rosea*, from Naples; magnified (S., 1 inch).

Fig. 4. Section through test of *Distaplia vallii*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Part of mantle of *Distaplia vallii*, from Mediterranean, showing pigmentation; magnified (S., 1 inch).

Fig. 6. Part of branchial sac of *Distaplia vallii*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Colony of *Symplegma viride*; natural size.

Fig. 8. Part of test of *Symplegma viride*, showing vessels; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Part of outer layer of test of *Symplegma viride*, showing network of vessels; magnified (S., 1 inch).

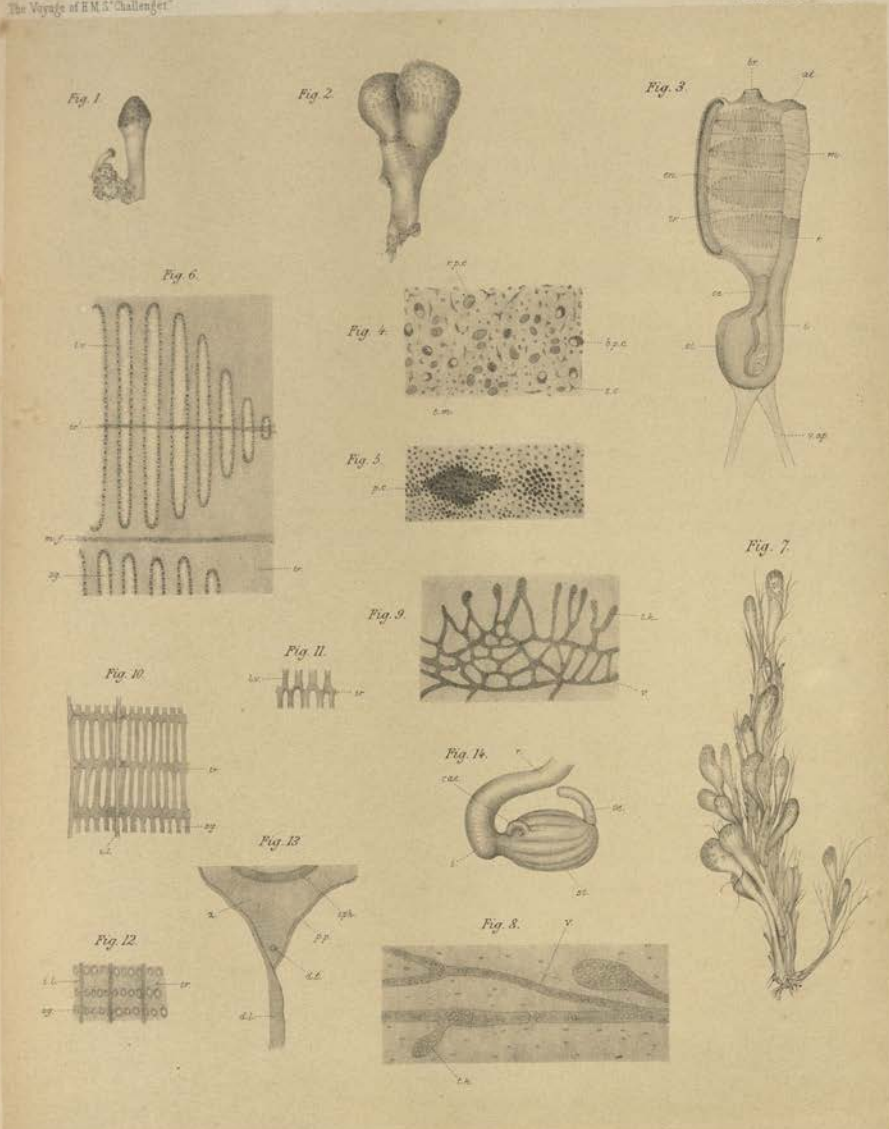
Fig. 10. Part of branchial sac of *Symplegma viride*; magnified (S., 1 inch).

Fig. 11. Small part of another branchial sac of *Symplegma viride*; magnified (S., 1 inch).

Fig. 12. Part of branchial sac of young Ascidiozooid of *Symplegma viride*, showing internal longitudinal bars; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Dorsal part of anterior end of Ascidiozooid of *Symplegma viride*, showing dorsal lamina, &c.; tentacles not represented; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 14. Alimentary canal of *Symplegma viride*; magnified (S., 1 inch).



W. A. Bachman del.

F. Huth, Lith. Edinr.

FIGS 1-6, DISTAPLIA VALLII, n. sp. FIGS 7-14, SYMPLEGMA VIRIDE, n. sp.

PLATE XIX.

PLATE XIX.

Cystodytes draschii, n. sp.

ad.p. Adhering papilla.
at. Atrial aperture.
at.si. Atrial siphon.
bl. Bladder cell.
br. Branchial aperture.
br.s. Branchial sac.
br.si. Branchial siphon.
cap. Calcareous capsule around Ascidiozooid.
en. Endostyle.
l.s. Lower surface of colony.
m. Mantle.
m.b. Muscle band in mantle.
mar. Free margin of colony.
n.g. Nerve ganglion.
s.o. Sense organ.
sp. Calcareous spicule in test.
sph. Sphincter.
t.c. Test cells.
t.c'. Modified test cells.
th. Thorax.
t.m. Test matrix.
tn, tn'. Tentacles.
u.s. Upper surface of colony.

Fig. 1. Colony of *Cystodytes draschii*; natural size.

Fig. 2. Part of section through test of *Cystodytes draschii*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of section through colony of *Cystodytes draschii*, showing relation of Ascidiozooid to test and calcareous spicules; magnified (S., 1 inch).

Fig. 4. Part of vertical section through colony of *Cystodytes draschii*, showing free margin, &c.; slightly enlarged.

Fig. 5. Ascidiozooid of *Cystodytes draschii*; natural size.

Fig. 6. Two calcareous spicules from the test of *Cystodytes draschii*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of calcareous capsule showing overlapping spicules; magnified (S., 1 inch).

Fig. 8. Connective-tissue cells from mantle of *Cystodytes draschii*; highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Part of mantle of *Cystodytes draschii*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Branchial siphon, &c., of *Cystodytes draschii*; highly magnified (Z., $\frac{1}{12}$).

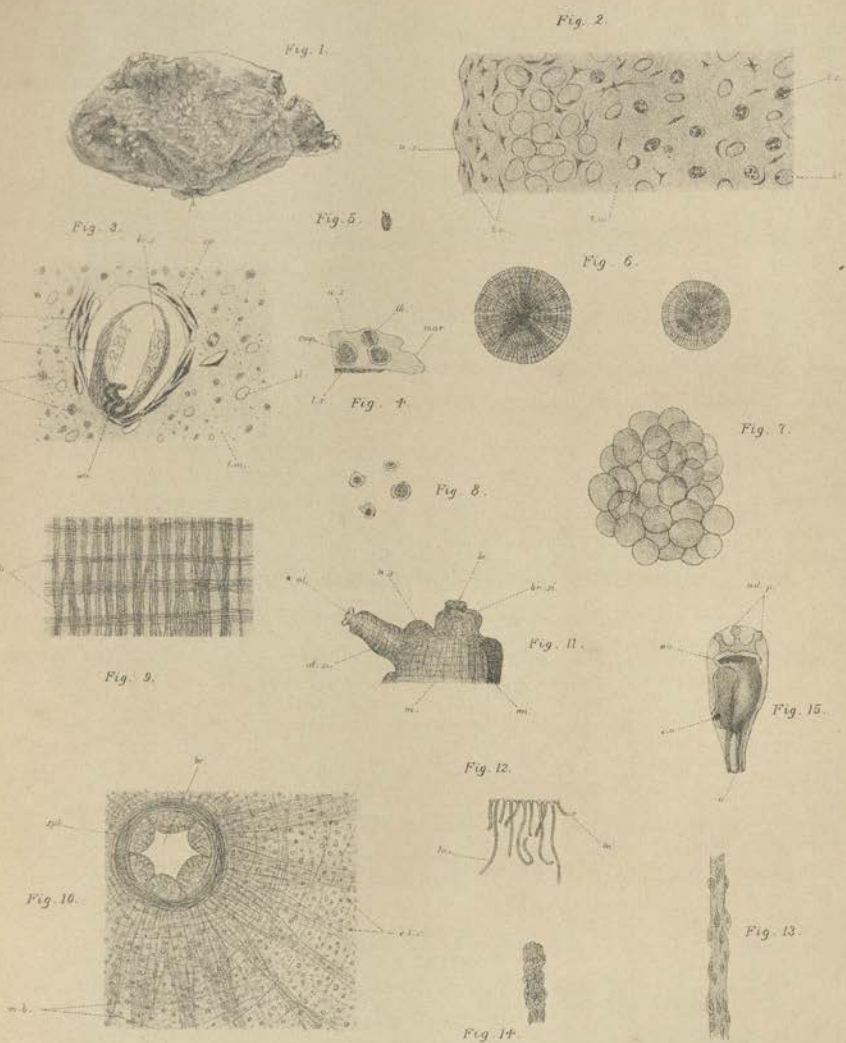
Fig. 11. Anterior end of Ascidiozooid of *Cystodytes draschii*; magnified (S., 1 inch).

Fig. 12. Tentacles of *Cystodytes draschii*; magnified (S., $\frac{1}{4}$ inch, reduced).

Fig. 13. Part of a tentacle of *Cystodytes draschii*; highly magnified (Z., $\frac{1}{12}$).

Fig. 14. Tip of a tentacle of *Cystodytes draschii*; highly magnified (Z., $\frac{1}{12}$).

Fig. 15. Tailed larva of *Cystodytes draschii*; magnified (S., 1 inch).



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CYSTODYTES DRASCHII. n. sp.

PLATE XX.

PLATE XX.

Cystodytes philippinensis, n. sp.

ab. Abdomen of Ascidiozooid.
at. Atrial aperture.
br. Branchial aperture.
bl. Bladder cell.
br.si. Branchial siphon.
cap. Calcareous capsule around Ascidiozooid.
l.s. Lower surface of colony.
m. Mantle.
mar. Free margin of colony.
sg. Stigmata of branchial sac.
sp. Calcareous spicule in test.
t. Test.
t.c. Test cells.
t.c'. Modified test cells.
th. Thorax of Ascidiozooid.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
u.s. Upper surface of colony.

Fig. 1. Colony of *Cystodytes philippinensis*; natural size.

Fig. 2. Another colony of *Cystodytes philippinensis*; natural size.

Fig. 3. Vertical section of part of colony of *Cystodytes philippinensis*; slightly enlarged.

Fig. 4. Calcareous spicules from test of *Cystodytes philippinensis*; A, from side, B, from edge; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of section of colony of *Cystodytes philippinensis*, showing relation of Ascidiozooid to test and spicules; magnified (S., 1 inch).

Fig. 6. Section of test of *Cystodytes philippinensis*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Anterior part of Ascidiozooid of *Cystodytes philippinensis*; magnified (S., 1 inch).

Fig. 8. Part of branchial sac of *Cystodytes philippinensis*; magnified (S., 1 inch).

Fig. 9. Part of test from lower surface of colony of *Cystodytes philippinensis*; magnified (S., 1 inch).

Fig. 10. Surface layer of test of *Cystodytes philippinensis*, seen from interior, showing branchial apertures; magnified (S., 1 inch).

Fig. 11. Diagrammatic vertical section of colony of *Cystodytes philippinensis*, showing arrangement of Ascidiozooids and their relation to calcareous capsule; magnified.

Fig. 12. Part of vertical section of upper surface of colony of *Cystodytes philippinensis*, showing structure of test; magnified (S., 1 inch).

Fig. 1.

Fig. 2.

Fig. 7.

Fig. 4.

Fig. 3.

Fig. 8.

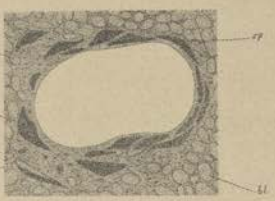
Fig. 5.

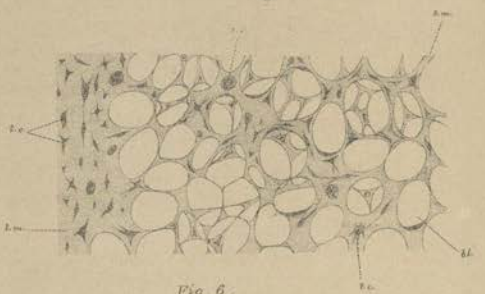
Fig. 6.

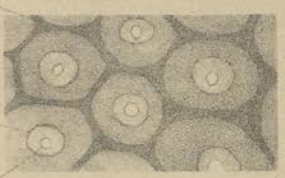
Fig. 10.

Fig. 9.

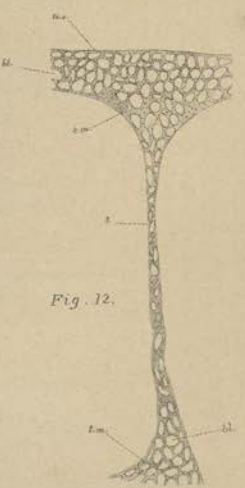
Fig. 12.

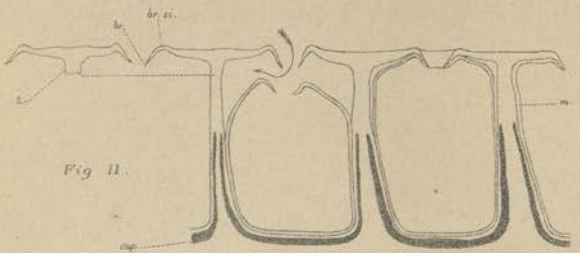
Fig. 11.

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CYSTODYTES PHILIPPINENSIS, n. sp.

PLATE XXI.

PLATE XXI.

Pharyngodictyon mirabile, n. sp.

i.l. Internal longitudinal bar of branchial sac.	*tr.* Transverse vessel of branchial sac.	*t.v.* Spermatic vesicles.
m.f. Muscle fibres.	*t.c.* Test cells.	*v.d.* Vas deferens.
	t.m. Test matrix.	

Fig. 1. Colony of *Pharyngodictyon mirabile;* natural size.

Fig. 2. Another colony of *Pharyngodictyon mirabile;* natural size.

Fig. 3. Two colonies of *Pharyngodictyon mirabile;* natural size.

Fig. 4. Ascidiozooid of *Pharyngodictyon mirabile;* slightly enlarged.

Fig. 5. Ascidiozooid of *Pharyngodictyon mirabile,* seen from left side; magnified (S., 1 inch).

Fig. 6. Section through test of *Pharyngodictyon mirabile;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Section through part of colony of *Pharyngodictyon mirabile,* to show arrangement of Ascidiozooids; magnified (S., 1 inch).

Fig. 8. Part of mantle of *Pharyngodictyon mirabile,* showing muscle bands; magnified (S., 1 inch).

Fig. 9. Muscle band, from mantle; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. Muscle fibre, from mantle; more highly magnified (Z., $\frac{1}{12}$).

Fig. 11. Another muscle fibre, from mantle; highly magnified (Z., $\frac{1}{12}$).

Fig. 12. Part of branchial sac of *Pharyngodictyon mirabile;* magnified (S., 1 inch).

Fig. 13. Edge of a vessel, from branchial sac; highly magnified (S., $\frac{1}{6}$ inch).

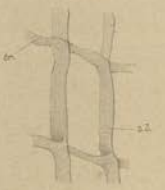
Fig. 14. Tentacle of *Pharyngodictyon mirabile,* seen from side; magnified (S., 1 inch).

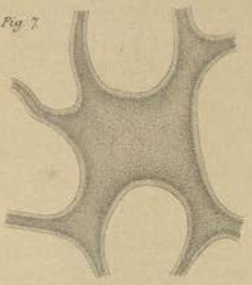
Fig. 15. Small part of tentacle of *Pharyngodictyon mirabile,* seen from side; highly magnified (S., $\frac{1}{6}$ inch).

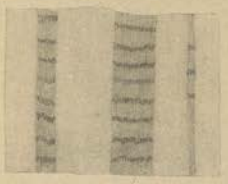
Fig. 16. Anterior extremity of endostyle of *Pharyngodictyon mirabile;* magnified (S., 1 inch).

Fig. 17. Part of male reproductive organs of *Pharyngodictyon mirabile;* magnified (S., 1 inch).

Fig. 18. Oblique section through post-abdomen of Ascidiozooid of *Pharyngodictyon mirabile;* magnified (S., 1 inch).







PHARYNGODICTYON MIRABILE, n. sp.

PLATE XXII.

PLATE XXII.

Tylobranchion speciosum, n. sp.

b.s. Blood sinus.
d.t. Dorsal tubercle.
d.l. Dorsal lamina.
ec. Ectoderm.
g.t. Germinal tubule.
h.m. Horizontal membrane of branchial sac.
l. Languet.
m.b. Muscle band in mantle.
o. Ovum.
p. Papilla.
p.p. Peripharyngeal band.
sg. Stigmata of branchial sac.
sph. Sphincter.
t.c. Test cells.
t.m. Test matrix.
tn. Tentacles.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.d. Vas deferens.

Fig. 1. Colony of *Tylobranchion speciosum;* natural size.

Fig. 2. Ascidiozooid of *Tylobranchion speciosum;* natural size.

Fig. 3. Another Ascidiozooid with much larger post-abdomen; natural size.

Fig. 4. Ascidiozooid, seen from right hand side; magnified (S., 1 inch).

Fig. 5. Part of test of *Tylobranchion speciosum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Part of endostyle of *Tylobranchion speciosum*, seen from ventral surface; magnified (S., 1 inch).

Fig. 7. Part of branchial sac of *Tylobranchion speciosum*, seen from the interior; magnified (S., 1 inch).

Fig. 8. Part of another branchial sac, from interior; magnified (S., 1 inch).

Fig. 9. Another part of the branchial sac, from interior; magnified (S., 1 inch).

Fig. 10. Small part of branchial sac; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 11. Three ciliated cells, from stigmata; highly magnified (S., $\frac{1}{6}$ inch, enlarged).

Fig. 12. Part of dorsal edge of branchial sac, showing languets; magnified (S., 1 inch).

Fig. 13. Dorsal part of anterior end of Ascidiozooid, showing tentacles, &c.; magnified (S., 1 inch).

Fig. 14. Diagrammatic transverse section of post-abdomen, showing tubules in which the reproductive elements are produced; magnified.

Fig. 15. Part of germinal tubule, from young Ascidiozooid, showing ova in various stages of development; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 16. Part of smaller tubules, containing young ova; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 17. Tubules from older Ascidiozooid, in which spermatozoa are being produced; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 7.

Fig. 6.

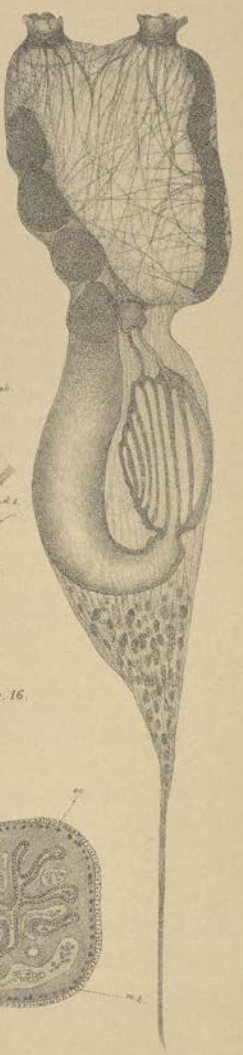


Fig. 4.

Fig. 5.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 13.

Fig. 12.

Fig. 15.

Fig. 16.

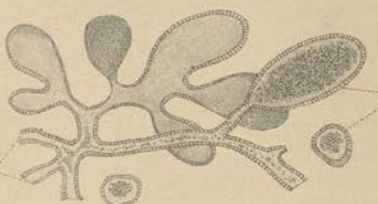


Fig. 17.

Fig. 14.

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TYLOBRANCHION SPECIOSUM, n. sp.

PLATE XXIII.

PLATE XXIII.

Figs. 1–6. *Atopogaster gigantea*, n. sp.
Figs. 7–13. *Atopogaster aurantiaca*, n. sp.

bl. Bladder cell.
br. Branchial aperture.
ep. Band of thickened epithelium connecting languets on dorsal lamina.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l. Dorsal languet.
m.f. Muscle fibres.
œ. Œsophagus.
p.ab. Post-abdomen.
p.c. Mass of pigment cells.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
v. Vessel in test.

Fig. 1. Colony of *Atopogaster gigantea;* one half natural size.

Fig. 2. Part of surface of *Atopogaster gigantea*, showing systems; slightly enlarged.

Fig. 3. Ascidiozooid of *Atopogaster gigantea*, from left side; magnified (S., 1 inch).

Fig. 4. Part of branchial sac of *Atopogaster gigantea;* magnified (S., 1 inch).

Fig. 5. Branchial siphon and lobes of *Atopogaster gigantea;* magnified (S., 1 inch).

Fig. 6. Larva of *Atopogaster gigantea;* magnified (S., 1 inch).

Fig. 7. Colony of *Atopogaster aurantiaca;* natural size.

Fig. 8. Branchial siphon and lobes of *Atopogaster aurantiaca;* magnified (S., 1 inch).

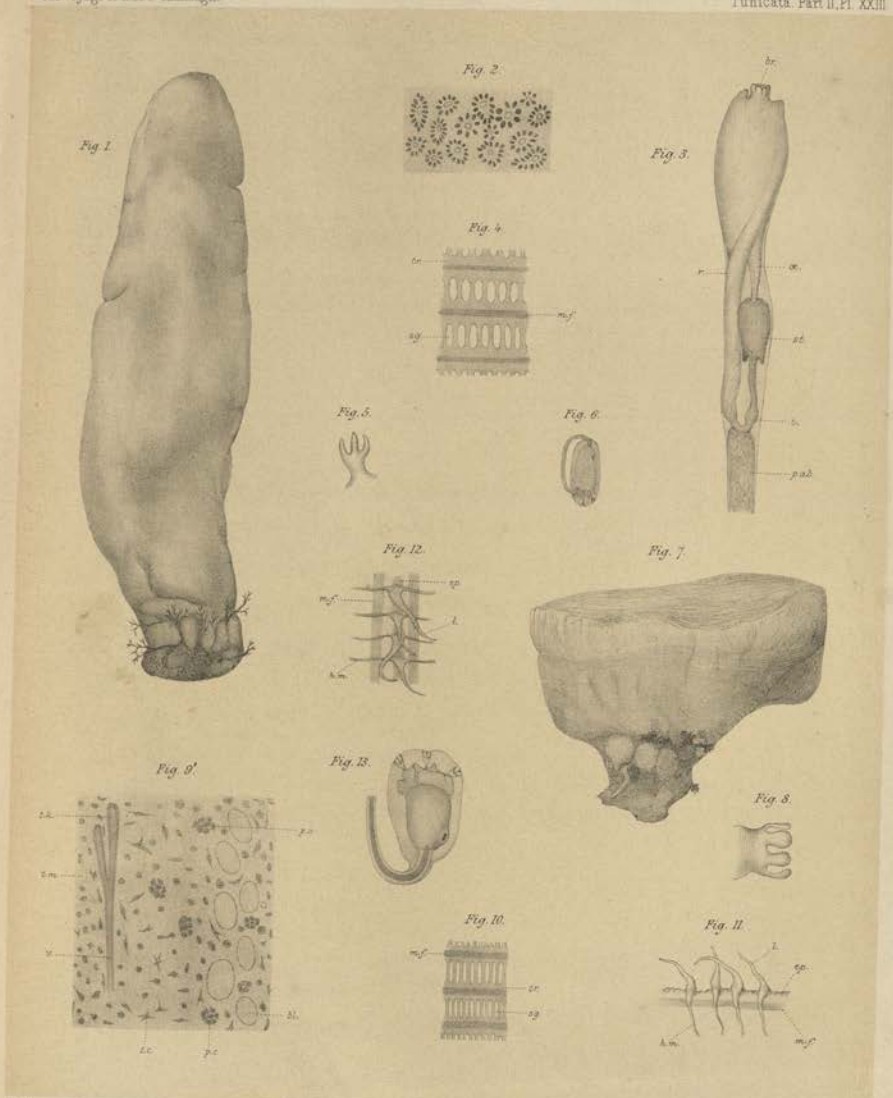
Fig. 9. Section of test of *Atopogaster aurantiaca;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Part of branchial sac of *Atopogaster aurantiaca;* magnified (S., 1 inch).

Fig. 11. Part of dorsal lamina of *Atopogaster aurantiaca*, from the side, showing languets; magnified (S., 1 inch).

Fig. 12. Part of dorsal lamina of *Atopogaster aurantiaca*, from the front, showing languets, &c.; magnified (S., 1 inch).

Fig. 13. Larva of *Atopogaster aurantiaca;* magnified (S., 1 inch).



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FIGS 1-6, ATOPOGASTER GIGANTEA, n. sp. FIGS 7-13, ATOPOGASTER AURANTIACA, n. sp.

PLATE XXIV.

PLATE XXIV.

Figs. 1–8. *Atopogaster elongata*, n. sp.
Figs. 9, 10. *Atopogaster elongata*, var. *pallida*, nov.
Figs. 11–15. *Atopogaster informis*, n. sp.
Figs. 16–20. *Morchellioides affinis*, n. sp.

ab. Abdomen of Ascidiozooid.
ar. Prolongation of branchial sac in post-abdomen.
at. Atrial aperture.
a.z. Ascidiozooid.
br. Branchial aperture.
br.l. Lobe of branchial aperture.
cæ. Cæcal thickening in wall of stomach.
cœl. Space in mesoderm of post-abdomen.
d.l. Dorsal lamina.
ec. Ectoderm.
end. Endoderm.
i. Intestine.
l. Languet.
mes. Mesoderm cells.
m.f. Muscle fibres.
œ. Œsophagus.
p.ab. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t. Test.
t.c. Test cells.
th. Thorax of Ascidiozooid.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
v.ap. Vascular appendage.

Fig. 1. Colony of *Atopogaster elongata;* natural size.

Fig. 2. Another colony of *Atopogaster elongata;* natural size.

Fig. 3. Another colony of *Atopogaster elongata;* natural size.

Fig. 4. Ascidiozooid of *Atopogaster elongata*, seen from right side; magnified (S., 1 inch).

Fig. 5. Part of test of *Atopogaster elongata;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Part of branchial sac of *Atopogaster elongata;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Diagram of alimentary canal of *Atopogaster elongata;* magnified (S., 1 inch, enlarged).

Fig. 8. Transverse section of post-abdomen of *Atopogaster elongata;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Colony of *Atopogaster elongata*, var. *pallida;* natural size.

Fig. 10. Part of section of test of *Atopogaster elongata*, var. *pallida;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 11. Part of section of colony of *Atopogaster informis;* natural size.

Fig. 12. Part of branchial sac of *Atopogaster informis;* magnified (S., 1 inch).

Fig. 13. Part of another branchial sac of *Atopogaster informis;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 14. Part of dorsal lamina of *Atopogaster informis*, seen from the side; magnified (S., 1 inch).

Fig. 15. Larva of *Atopogaster informis;* magnified (S., 1 inch).

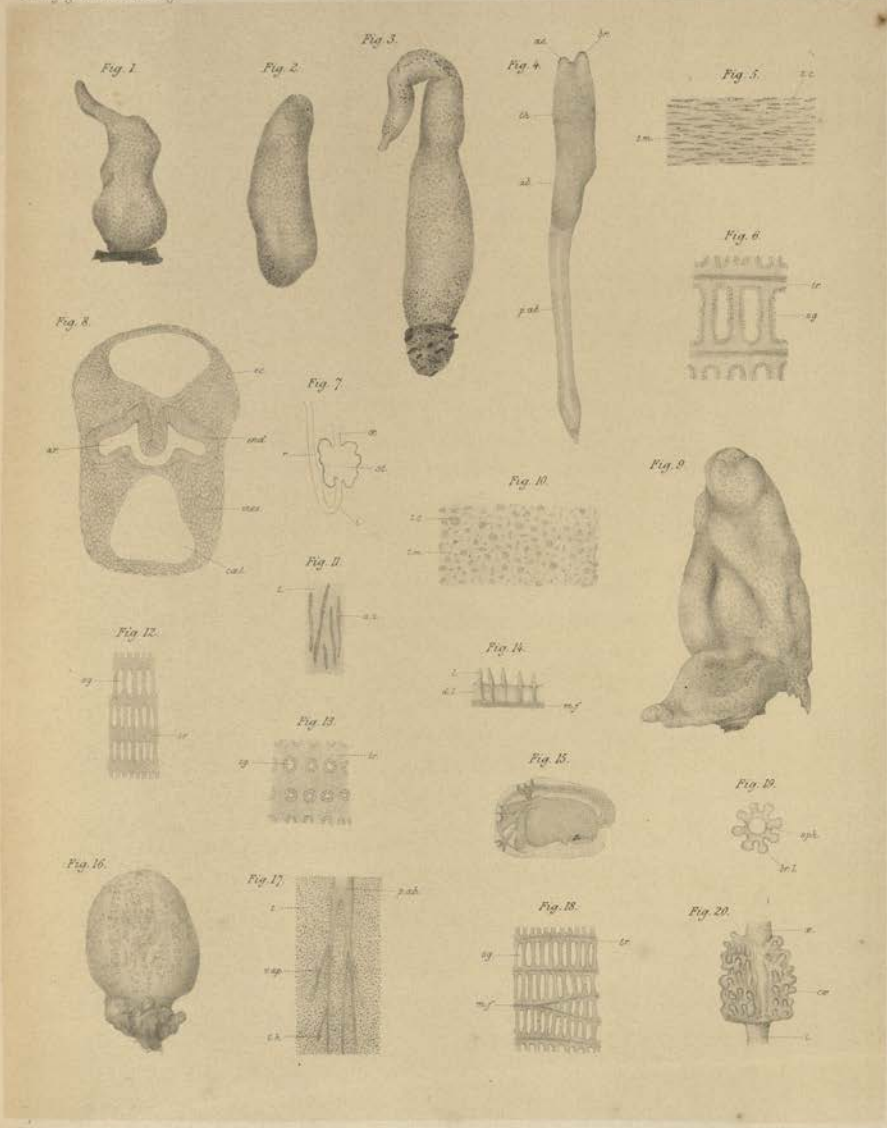
Fig. 16. Colony of *Morchellioides affinis;* natural size.

Fig. 17. Section through test of *Morchellioides affinis*, showing end of post-abdomen of Ascidiozooid and branched vascular appendages ending in bulbs; magnified (S., 1 inch).

Fig. 18. Part of branchial sac of *Morchellioides affinis*, showing a transverse vessel branching; magnified (S., 1 inch).

Fig. 19. Branchial aperture of Ascidiozooid of *Morchellioides affinis*, from above, showing eight lobes; magnified (S., 1 inch).

Fig. 20. Stomach of Ascidiozooid of *Morchellioides affinis*, showing irregular thickening of walls; magnified (S., 1 inch).



FIGS 1-8, ATOPOGASTER ELONGATA, n. sp. FIGS 9 & 10, ATOPOGASTER ELONGATA var. PALLIDA, nov.
FIGS 11-15, ATOPOGASTER INFORMIS, n. sp. FIGS 16-20, MORCHELLIOIDES AFFINIS, n. sp.

PLATE XXV.

PLATE XXV.

Figs. 1–3. *Morchellium giardi*, n. sp.
Figs. 4–6. *Sidnyum pallidum*, n. sp.
Figs. 7–9. *Polyclinum molle*, n. sp.
Figs. 10–12. *Polyclinum minutum*, n. sp.
Figs. 13, 14. *Amaroucium hepaticum*, n. sp.
Figs. 15, 16. *Aplidium crassum*, n. sp.

at. Atrial aperture.
ab. Abdomen.
bl. Bladder cell.
br.l. Lobe of branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
m.f. Muscle fibres.
o. Ova.
œ. Œsophagus.
p.ab. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
sg.c. Ciliated cells bounding stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t.c. Test cells.
th. Thorax.
t.k. Terminal bulb on vessel in test.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v. Vessel in test.
v.d. Vas deferens.

Fig. 1. Colony of *Morchellium giardi;* natural size.

Fig. 2. Part of branchial sac of *Morchellium giardi;* magnified (S., 1 inch).

Fig. 3. Stomach of *Morchellium giardi*, showing irregular thickening of wall; magnified (S., 1 inch).

Fig. 4. Colony of *Sidnyum pallidum;* natural size.

Fig. 5. Part of branchial sac of *Sidnyum pallidum;* magnified (S., 1 inch).

Fig. 6. Ascidiozooid of *Sidnyum pallidum*, from left side; magnified (S., 1 inch).

Fig. 7. Colony of *Polyclinum molle;* natural size.

Fig. 8. Part of branchial sac of *Polyclinum molle;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Ascidiozooid of *Polyclinum molle*, seen from right side; magnified (S., 1 inch).

Fig. 10. Colony of *Polyclinum minutum;* natural size.

Fig. 11. Ascidiozooid of *Polyclinum minutum*, seen from right side; magnified (S., 1 inch).

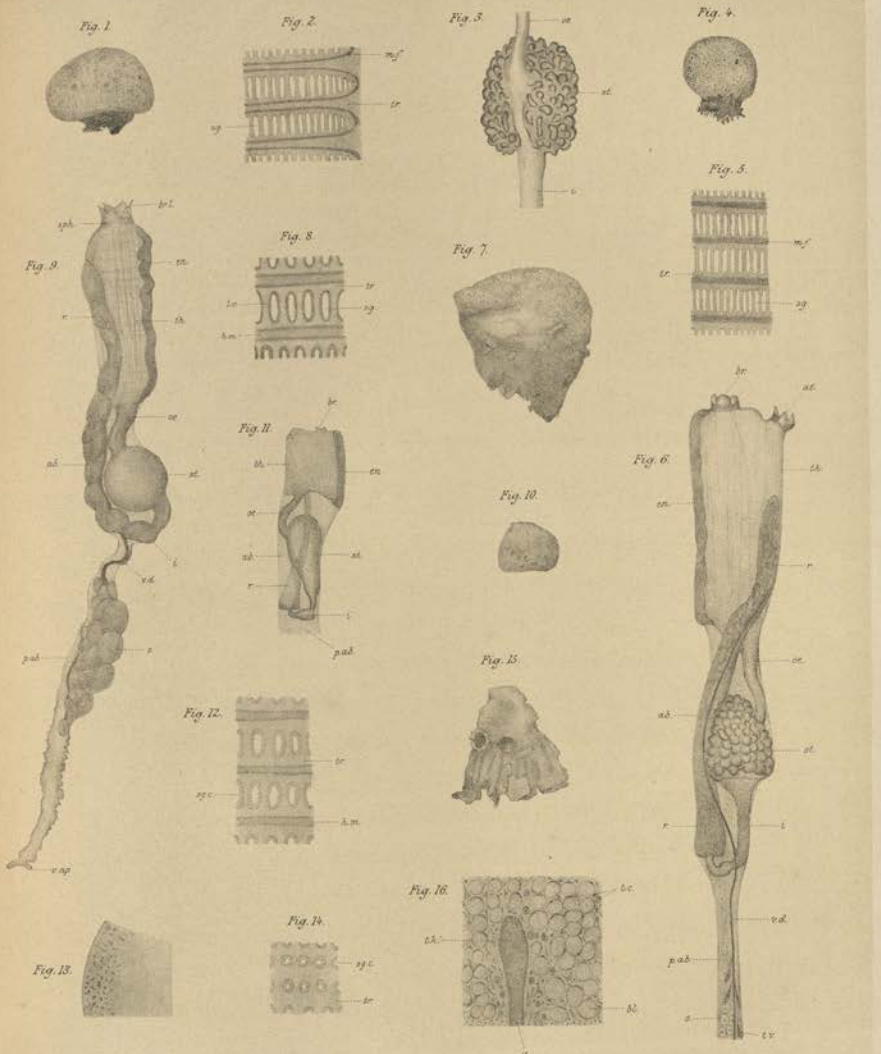
Fig. 12. Part of branchial sac of *Polyclinum minutum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Part of slice of colony of *Amaroucium hepaticum;* natural size.

Fig. 14. Part of branchial sac of *Amaroucium hepaticum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Colony of *Aplidium crassum;* natural size.

Fig. 16. Part of section of test of *Aplidium crassum;* highly magnified (S., $\frac{1}{6}$ inch).



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FIG^s 1-3, MORCHELLIUM GIARDI, n. sp. FIG^s 4-6, SIDNYUM PALLIDUM, n. sp. FIG^s 7-9, POLYCLINUM MOLLE, n. sp.
FIG^s 10-12, POLYCLINUM MINUTUM, n. sp. FIG^s 13 & 14, AMAROUCIUM HEPATICUM n. sp. FIG^s 15 & 16, APLIDIUM CRASSUM, n. sp.

PLATE XXVI.

PLATE XXVI.

Figs. 1–4. *Polyclinum pyriforme*, n. sp.
Figs. 5–7. *Polyclinum depressum*, n. sp.
Figs. 8, 9. *Aplidium fumigatum*, n. sp.
Fig. 10. *Polyclinum incertum*, n. sp.
Figs. 11, 12. *Amaroucium albidum*, n. sp.

ab. Abdomen.
at. Atrial aperture.
br. Branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
i'. Constriction between intestine and rectum.
l. Dorsal languet.
m.f. Muscle fibres.
œ. Œsophagus.
p.ab. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.c'. Modified test cells.
th. Thorax.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
v.d. Vas deferens.

Fig. 1. Colony of *Polyclinum pyriforme;* natural size.

Fig. 2. Part of branchial sac of *Polyclinum pyriforme;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of dorsal edge of branchial sac of *Polyclinum pyriforme*, showing languets; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Ascidiozooid of *Polyclinum pyriforme*, seen from right side; magnified (S., 1 inch).

Fig. 5. Colony of *Polyclinum depressum*, seen from upper surface; natural size.

Fig. 6. Ascidiozooid of *Polyclinum depressum*, seen from left side; magnified (S., 1 inch).

Fig. 7. Another Ascidiozooid of *Polyclinum depressum*, seen from right side; magnified (S., 1 inch).

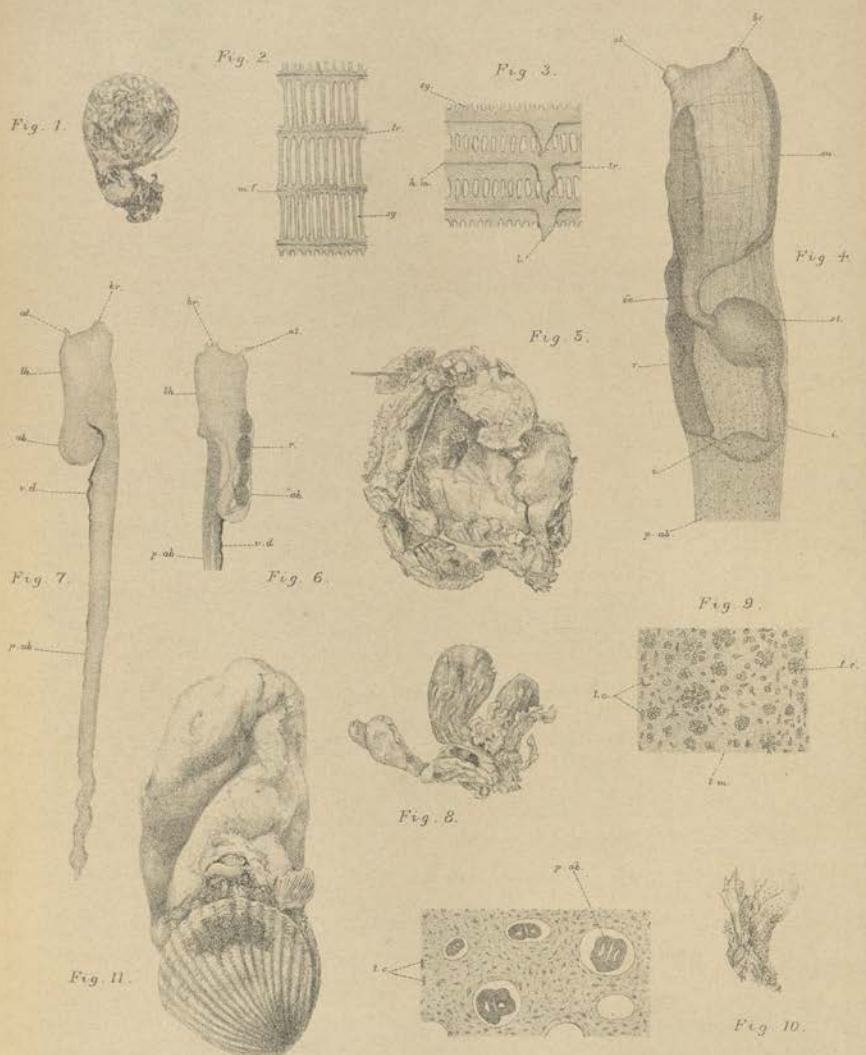
Fig. 8. Colony of *Aplidium fumigatum;* natural size.

Fig. 9. Part of test of *Aplidium fumigatum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. Colony of *Polyclinum incertum;* natural size.

Fig. 11. Colony of *Amaroucium albidum;* natural size.

Fig. 12. Part of section of colony of *Amaroucium albidum*, showing transverse sections of the post-abdomen of Ascidiozooids; magnified (S., 1 inch).



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FIGS 1-4, POLYCLINUM PYRIFORME, n. sp.
FIGS 5-7, POLYCLINUM DEPRESSUM, n. sp.
FIGS 8-9, APLIDIUM FUMIGATUM, n. sp.
FIG. 10, POLYCLINUM INCERTUM, n. sp.
FIGS 11-12 AMAROUCIUM ALBIDUM, n. sp.

PLATE XXVII.

PLATE XXVII.

Figs. 1, 2. ———— (?) *clava*, n. sp.
Figs. 3–8. *Aplidium incrustans*, n. sp.
Figs. 9–12. *Amaroucium colelloides*, n. sp.

bl. Bladder cell.
f.p. Foreign particle in test.
l. Languet.
l.v. Fine longitudinal vessels of branchial sac.
m.f. Muscle fibres.
o. Ovum.
o.s. Outer surface of test.
p.c. Pigment cell in test.
pig. Mass of pigment cells.
sg. Stigmata of branchial sac.
sph. Sphincter.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tn, tn'. Tentacles.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of ———— (?) *clava;* natural size.

Fig. 2. Section of test of ———— (?) *clava;* magnified (S., 1 inch).

Fig. 3. Colony of *Aplidium incrustans;* natural size.

Fig. 4. Part of test of *Aplidium incrustans,* showing imbedded foreign particles; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Part of branchial sac of *Aplidium incrustans;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Three of the ciliated cells from the stigmata of *Aplidium incrustans;* more highly magnified (Z., $\frac{1}{12}$).

Fig. 7. Part of dorsal lamina of *Aplidium incrustans,* showing two languets; highly magnified (S., $\frac{1}{4}$ inch).

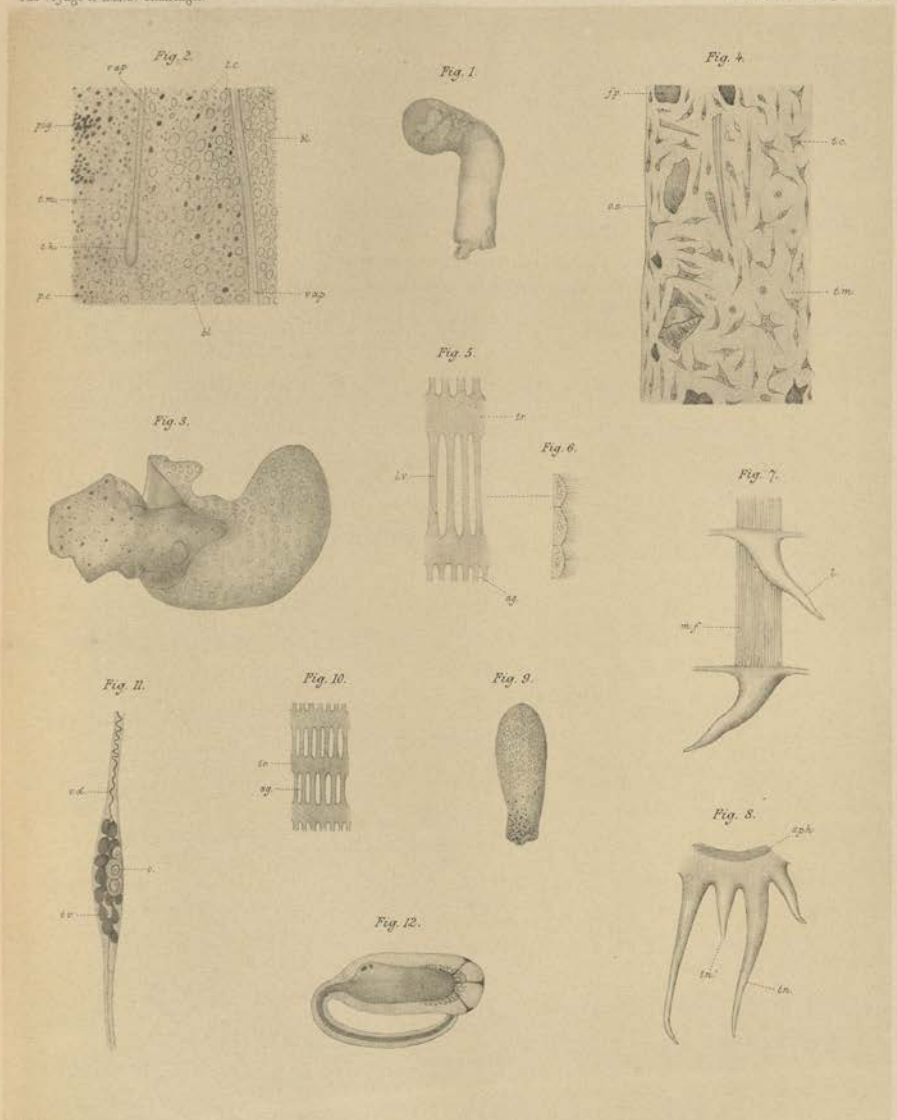
Fig. 8. Tentacles of *Aplidium incrustans;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Colony of *Amaroucium colelloides;* natural size.

Fig. 10. Part of branchial sac of *Amaroucium colelloides;* magnified (S., 1 inch).

Fig. 11. Reproductive organs of *Amaroucium colelloides* in post-abdomen; magnified (S., 1 inch).

Fig. 12. Larva of *Amaroucium colelloides;* highly magnified (S., $\frac{1}{4}$ inch).



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FIG^s 1 & 2, ——— (?) CLAVA n. sp. FIG^s 3-8, APLIDIUM INCRUSTANS, n. sp.
FIG^s 9-12, AMAROUCIUM COLELLOIDES, n. sp.

PLATE XXVIII.

PLATE XXVIII.

Figs. 1–4. *Aplidium fallax*, Johnston.
Figs. 5–7. *Aplidium leucophæum*, n. sp.
Figs. 8–10. *Aplidium fuscum*, n. sp.
Figs. 11–13. *Aplidium despectum*, n. sp.
Figs. 14, 15. ———— (?) *ignotus*, n. sp.

at. Atrial aperture.
at.l. Atrial languet.
br. Branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l. Languet.
l.v. Fine longitudinal vessels of branchial sac.
p.ab. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
sg'. Small stigmata.
st. Stomach.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessels of branchial sac.

Fig. 1. Two colonies of *Aplidium fallax;* natural size.

Fig. 2. Ascidiozooid of *Aplidium fallax*, seen from left side; magnified (S., 1 inch).

Fig. 3. Part of branchial sac of *Aplidium fallax*, showing diminution of stigmata (*sg*, *sg'*) at ventral edge; magnified (S., 1 inch).

Fig. 4. Dorsal part of branchial sac of *Aplidium fallax*, showing languets; magnified (S., 1 inch).

Fig. 5. Colony of *Aplidium leucophæum;* natural size.

Fig. 6. Ascidiozooid of *Aplidium leucophæum*, seen from left side; magnified (S., 1 inch).

Fig. 7. Dorsal part of branchial sac of *Aplidium leucophæum*, showing stigmata and languets; magnified (S., 1 inch).

Fig. 8. Colony of *Aplidium fuscum;* natural size.

Fig. 9. Part of branchial sac of *Aplidium fuscum;* magnified (S., 1 inch).

Fig. 10. Anterior end of Ascidiozooid of *Aplidium fuscum*, showing branchial and atrial apertures; magnified (S., 1 inch).

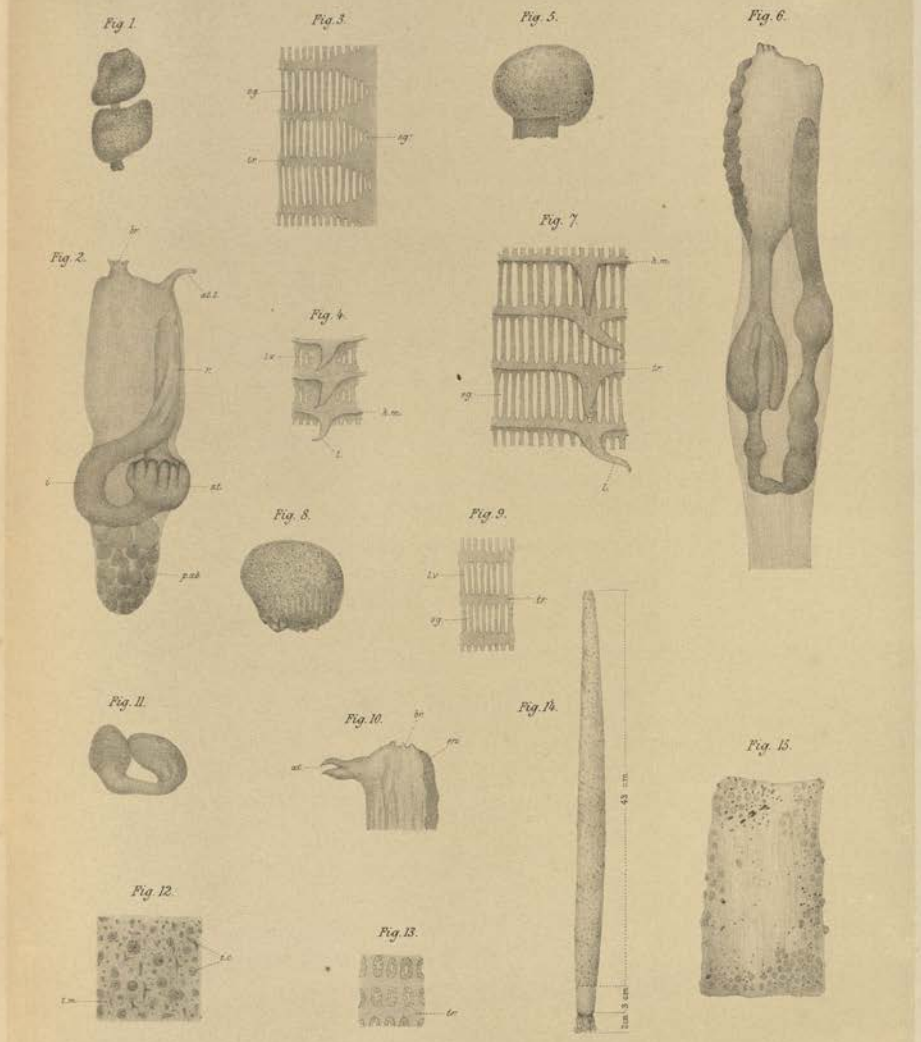
Fig. 11. Colony of *Aplidium despectum;* natural size.

Fig. 12. Section of test of *Aplidium despectum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 13. Part of branchial sac of *Aplidium despectum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Colony of ———— (?) *ignotus;* reduced (see measurements).

Fig. 15. Part of colony of ———— (?) *ignotus;* natural size.



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FIG^s 1-4, APLIDIUM FALLAX, Johnston. FIG^s 5-7, APLIDIUM LEUCOPHAEUM, n. sp. FIG^s 8-10, APLIDIUM FUSCUM, n. sp.
FIG^s 11-13, APLIDIUM DESPECTUM, n. sp. FIG^s 14 & 15, ——— IGNOTUS, n. sp.

PLATE XXIX.

PLATE XXIX.

Figs. 1–5. *Amaroucium globosum*, n. sp.
Fig. 6. *Amaroucium variabile*, var. *tenerum*, nov.
Figs. 7–12. *Amaroucium variabile*, n. sp.
Figs. 13–15. *Amaroucium recumbens*, n. sp.

at. Atrial aperture.
at.l. Atrial languet.
br. Branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l.v. Fine longitudinal vessels of branchial sac.
œ. Œsophagus.
p.ab. Post-abdomen.
r. Rectum.
st. Stomach.
t.c. Test cells.
th. Thorax.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.ap'. Rudimentary vascular appendages
v.d. Vas deferens.

Fig. 1. Large colony of *Amaroucium globosum;* natural size.

Fig. 2. Smaller colony of *Amaroucium globosum;* natural size.

Fig. 3. Part of branchial sac of *Amaroucium globosum*, from the smaller colony; magnified (S., 1 inch).

Fig. 4. Ascidiozooid of *Amaroucium globosum*, seen from left side; magnified (S., 1 inch).

Fig. 5. Part of male reproductive organs of *Amaroucium globosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Colonies of *Amaroucium variabile*, var. *tenerum;* natural size.

Fig. 7. Colony of *Amaroucium variabile;* natural size. The specimen figured belonged to the brown variety.

Fig 8. Section of the test of *Amaroucium variabile;* highly magnified (S., $\frac{1}{6}$ inch). This section was taken from a specimen of the brown variety.

Fig. 9. Ascidiozooid of *Amaroucium variabile*, seen from right side; magnified (S., 1 inch).

Fig. 10. Anterior end of Ascidiozooid of *Amaroucium variabile*, seen from right side, showing apertures and atrial languet; magnified (S., 1 inch, enlarged).

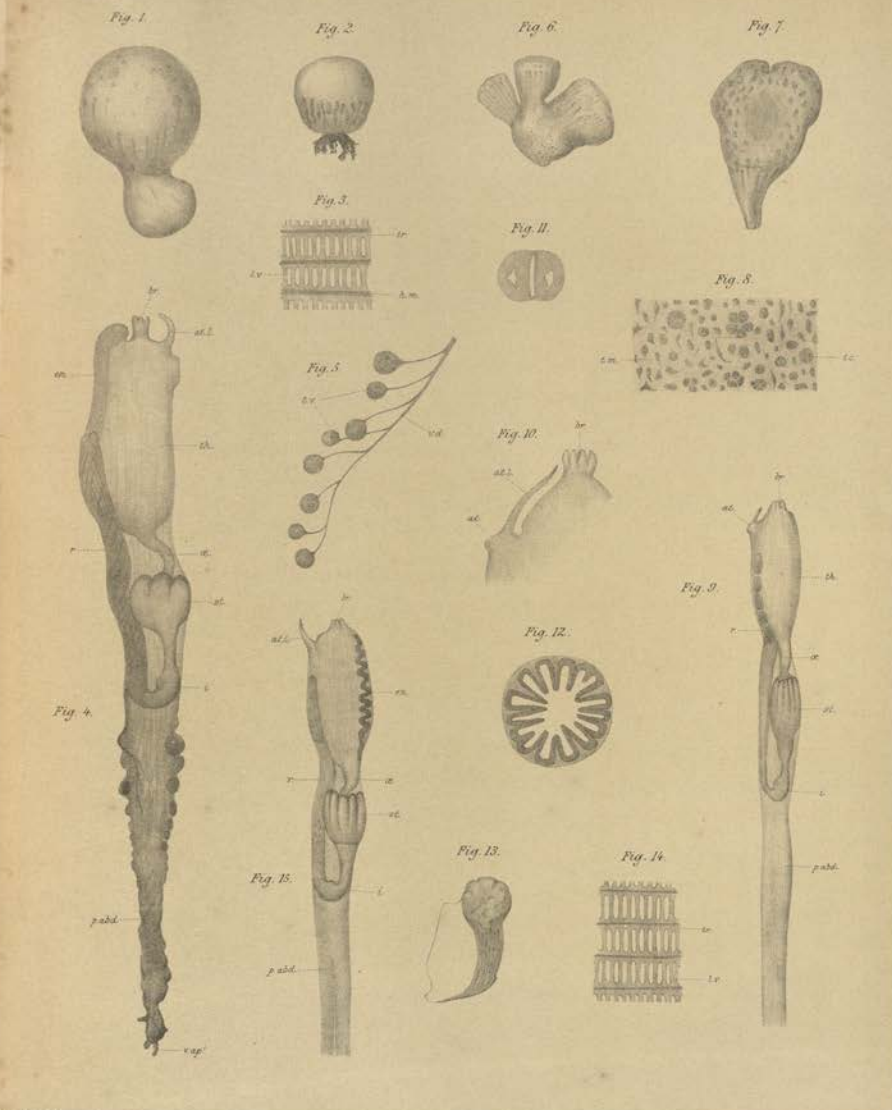
Fig. 11. Transverse section of post-abdomen of *Amaroucium variabile;* magnified (S., 1 inch).

Fig. 12. Transverse section of stomach of *Amaroucium variabile*, showing numerous folds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Colony of *Amaroucium recumbens;* natural size.

Fig. 14. Part of branchial sac of *Amaroucium recumbens;* magnified (S., 1 inch).

Fig. 15. Ascidiozooid of *Amaroucium recumbens*, seen from right side; magnified (S., 1 inch).



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FIGS. 1-5, AMAROUCIUM GLOBOSUM, n. sp. FIG. 6, AMAROUCIUM VARIABILE, var. TENERUM, nov.
FIGS. 7-12, AMAROUCIUM VARIABILE, n. sp. FIGS. 13-15, AMAROUCIUM RECUMBENS, n. sp.

PLATE XXX.

PLATE XXX.

Figs. 1–7. *Amaroucium irregulare*, n. sp.
Fig. 8. *Amaroucium irregulare*, var. *concinnum*, nov.
Figs. 9–11. *Amaroucium pallidulum*, n. sp.
Figs. 12–15. *Amaroucium lævigatum*, n. sp.
Figs. 16, 17. *Amaroucium complanatum*, n. sp.

abd. Abdomen.
at.l. Atrial languet.
br. Branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l.v. Fine longitudinal vessels of branchial sac.
œ. Œsophagus.
p.abd. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
th. Thorax.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.

Fig. 1. Colony of *Amaroucium irregulare;* natural size.

Fig. 2. Another colony of *Amaroucium irregulare;* natural size.

Fig. 3. Ascidiozooid of *Amaroucium irregulare*, seen from left side; magnified (S., 1 inch).

Fig. 4. Part of branchial sac of *Amaroucium irregulare;* magnified (S., 1 inch, enlarged).

Fig. 5. Stomach of *Amaroucium irregulare*, seen in optical section; magnified (S., 1 inch, enlarged).

Fig. 6. Alimentary canal of *Amaroucium irregulare;* magnified (S., 1 inch, enlarged).

Fig. 7. Transverse section of abdomen of *Amaroucium irregulare*, showing folds in stomach and rectum; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Colony of *Amaroucium irregulare*, var. *concinnum;* natural size.

Fig. 9. Colony of *Amaroucium pallidulum;* natural size.

Fig. 10. Part of branchial sac of *Amaroucium pallidulum;* magnified (S., 1 inch).

Fig. 11. Larva of *Amaroucium pallidulum;* magnified (S., 1 inch).

Fig. 12. Colony of *Amaroucium lævigatum;* natural size.

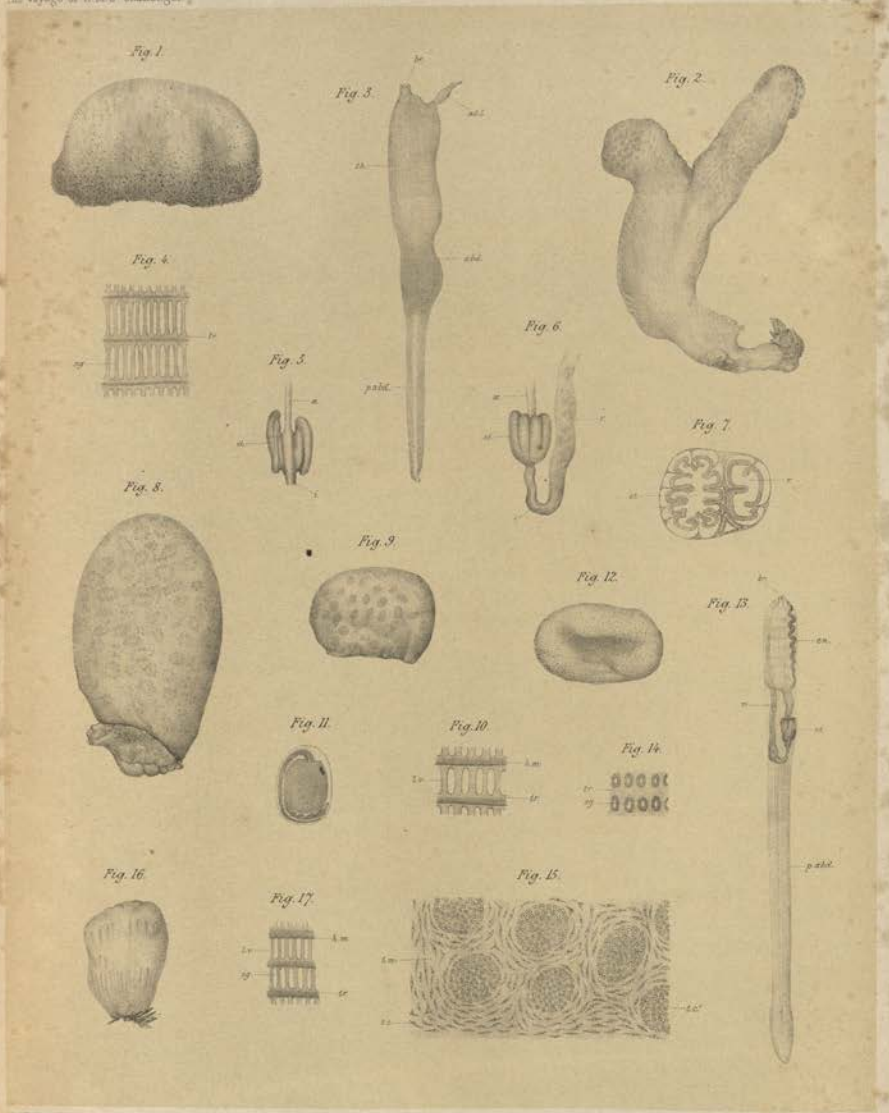
Fig. 13. Ascidiozooid of *Amaroucium lævigatum*, seen from right side; magnified (S., 1 inch).

Fig. 14. Part of branchial sac of *Amaroucium lævigatum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 15. Section of test of *Amaroucium lævigatum;* highly magnified (S., $\frac{1}{6}$ inch), showing arrangement of modified test cells (*t.c.*).

Fig. 16. Colony of *Amaroucium complanatum;* natural size.

Fig. 17. Part of branchial sac of *Amaroucium complanatum;* magnified (S., 1 inch, enlarged).



FIGS 1-7, AMAROUCIUM IRREGULARE, n. sp. FIG. 8, AMAROUCIUM IRREGULARE, var. CONCINNUM, nov.
FIGS 9-11, AMAROUCIUM PALLIDULUM, n. sp. FIGS 12-15, AMAROUCIUM LAEVIGATUM, n. sp.
FIGS 16 & 17, AMAROUCIUM COMPLANATUM, n. sp.

PLATE XXXI.

PLATE XXXI.

Figs. 1–4. *Psammaplidium rude*, n. sp.
Figs. 5–10. *Psammaplidium subviride*, n. sp.
Figs. 11, 12. *Psammaplidium exiguum*, n. sp.
Figs. 13–16. *Psammaplidium ovatum*, n. sp.
Figs. 17–19. *Amaroucium nigrum*, n. sp.

at. Atrial aperture.
at.l. Atrial languet.
br. Branchial aperture.
br.s. Branchial sac.
en. Endostyle.
l. Languet.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
m.b. Muscle band in mantle.
m.f. Muscle fibres.
n.g. Nerve ganglion.
o. Ovum.
œ. Œsophagus.
p.abd. Post-abdomen.
p.br. Peribranchial cavity.
p.c. Pigment cell.
sg. Stigmata of branchial sac.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.d. Vas deferens.

Fig. 1. Colony of *Psammaplidium rude;* natural size.

Fig. 2. Another colony of *Psammaplidium rude;* natural size.

Fig. 3. Anterior end of Ascidiozooid of *Psammaplidium rude*, seen from right side, showing apertures and atrial languet; magnified (S., 1 inch).

Fig. 4. Dorsal part of branchial sac of *Psammaplidium rude*, showing languets; magnified (S., 1 inch).

Fig. 5. Colony of *Psammaplidium subviride;* natural size.

Fig. 6. Part of branchial sac of *Psammaplidium subviride;* magnified (S., 1 inch).

Fig. 7. Anterior end of Ascidiozooid of *Psammaplidium subviride*, showing atrial languet; magnified (S., 1 inch).

Fig. 8. Dorsal languet of *Psammaplidium subviride;* magnified (S., 1 inch).

Fig. 9. Section of test of *Psammaplidium subviride*, showing imbedded foreign particles; magnified (S., 1 inch).

Fig. 10. Part of post-abdomen of *Psammaplidium subviride*, showing ova and spermatic vesicles; magnified (S., 1 inch).

Fig. 11. Colony of *Psammaplidium exiguum;* natural size.

Fig. 12. Part of branchial sac of *Psammaplidium exiguum;* magnified (S., 1 inch).

Fig. 13. Colony of *Psammaplidium ovatum;* natural size.

Fig. 14. Part of branchial sac of *Psammaplidium ovatum;* magnified (S., 1 inch).

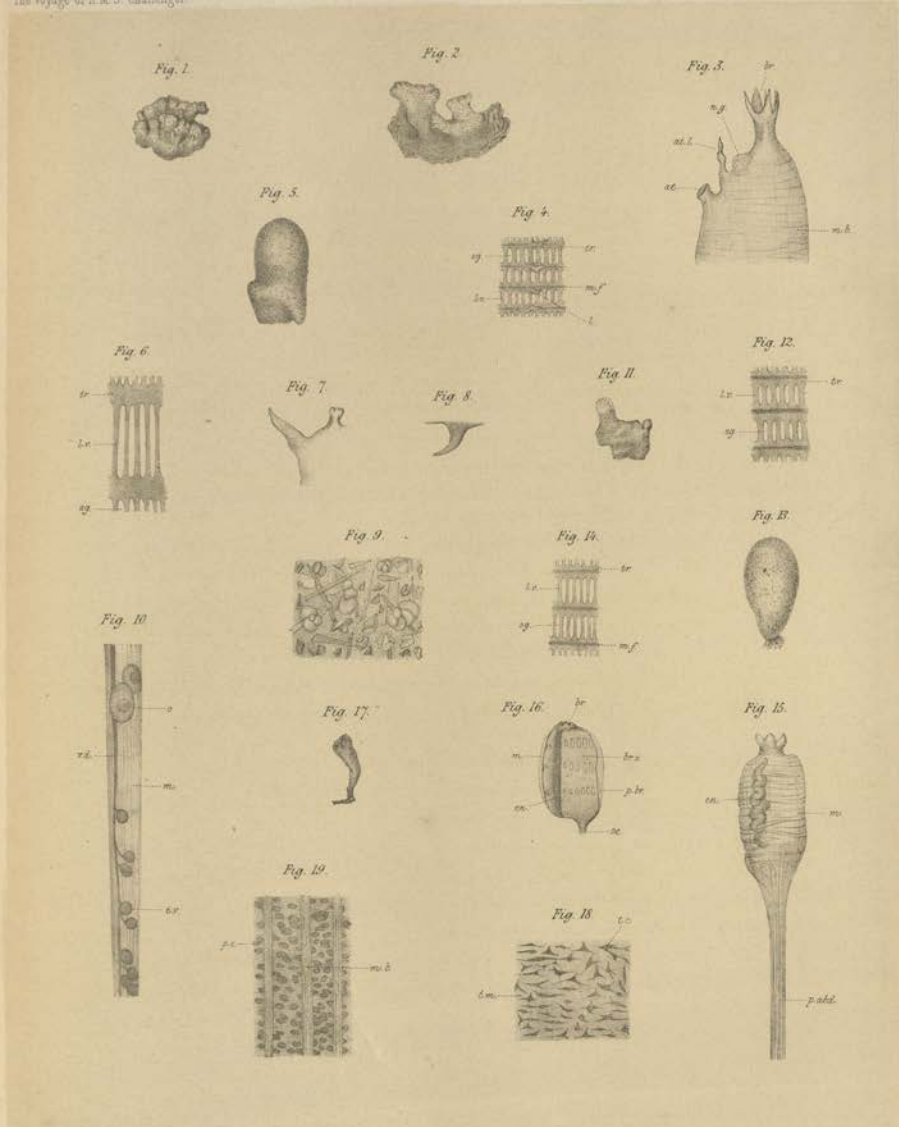
Fig. 15. Ascidiozooid of *Psammaplidium ovatum*, seen from ventral edge; magnified (S., 1 inch).

Fig. 16. Anterior part of young Ascidiozooid of *Psammaplidium ovatum*, cut open; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 17. Colony of *Amaroucium nigrum;* natural size.

Fig. 18. Section through test of *Amaroucium nigrum*, showing test cells; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 19. Part of mantle of *Amaroucium nigrum*, showing muscle bands and pigment cells; highly magnified (S., $\frac{1}{6}$ inch).



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FIG^s 1-4, PSAMMAPLIDIUM RUDE, n. sp. FIG^s 5-10, PSAMMAPLIDIUM SUBVIRIDE, n. sp.
FIG^s 11 & 12, PSAMMAPLIDIUM EXIGUUM, n. sp. FIG^s 13-16, PSAMMAPLIDIUM OVATUM, n. sp.
FIG^s 17-19, AMAROUCIUM NIGRUM, n. sp.

PLATE XXXII.

PLATE XXXII.

Figs. 1–5. *Psammaplidium spongiforme*, n. sp.
Figs. 6, 7. *Psammaplidium effrenatum*, n. sp.
Figs. 8–10. *Psammaplidium retiforme*, n. sp.
Figs. 11–13. *Psammaplidium flavum*, n. sp.

a. Anus.
ab. Abdomen.
at. Atrial aperture.
br. Branchial aperture.
br.l. Branchial lobe.
en. Endostyle.
i. Intestine.
m. Mantle.
m.b. Muscle band in mantle.
œ. Œsophagus.
p.ab Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Modified test cells.
t.f. Fibrous band in the test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.

Fig. 1. Large colony of *Psammaplidium spongiforme;* natural size.

Fig. 2. Ascidiozooid of *Psammaplidium spongiforme*, seen from right side; magnified (S., 1 inch).

Fig. 3. Part of branchial sac of *Psammaplidium spongiforme*, with unusually large stigmata; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of another branchial sac of *Psammaplidium spongiforme*, showing stigmata of the ordinary size; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Alimentary canal and post-abdomen of *Psammaplidium spongiforme;* magnified (S., 1 inch, enlarged).

Fig. 6. Colony of *Psammaplidium effrenatum;* natural size.

Fig. 7. Part of mantle of *Psammaplidium effrenatum;* magnified (S., 1 inch).

Fig. 8. Colony of *Psammaplidium retiforme;* natural size.

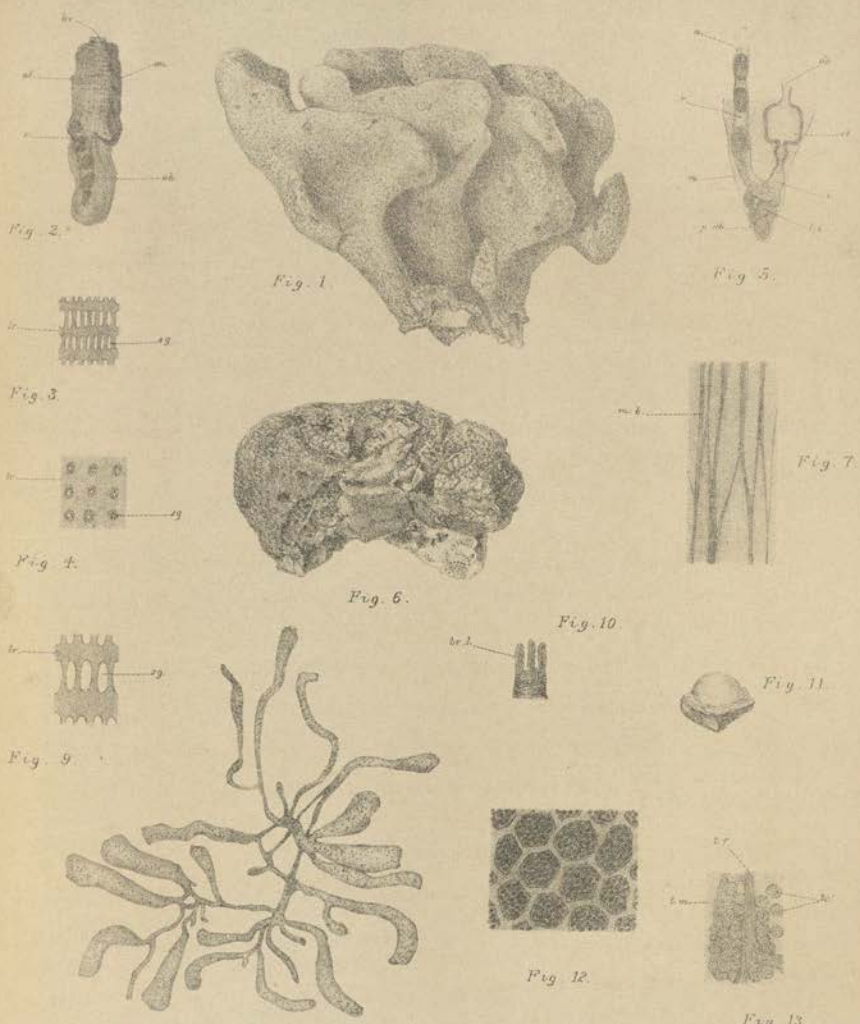
Fig. 9. Part of branchial sac of *Psammaplidium retiforme;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Branchial siphon and lobes of *Psammaplidium retiforme;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Colony of *Psammaplidium flavum;* natural size.

Fig. 12. Part of surface layer of test seen from interior; magnified (S., 1 inch).

Fig. 13. Small portion of surface layer of test seen in section, showing the fibrous bands of test matrix which separate the masses of modified test cells; highly magnified (S., $\frac{1}{6}$ inch).



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FIGS 1-5, PSAMMAPLIDIUM SPONGIFORME, n. sp. FIGS 8-10, PSAMMAPLIDIUM RETIFORME, n. sp.
FIGS 6-7, PSAMMAPLIDIUM EFFRENATUM, n. sp. FIGS 11-13, PSAMMAPLIDIUM FLAVUM, n. sp.

PLATE XXXIII.

PLATE XXXIII.

Figs. 1–8. *Didemnum aurantiacum*, n. sp.
Figs. 9–15. *Leptoclinum rubicundum*, n. sp.

br. Branchial aperture.	*sg.* Stigmata of branchial sac.	*tn.* Tentacles.
en. Endostyle.	*sp.* Calcareous spicule in test.	*tr.* Transverse vessel of branchial sac.
n.g. Nerve ganglion.	*sph.* Sphincter.	*v.ap.* Vascular appendage.
p.p. Peripharyngeal band.	*t.c.* Test cells.	

Fig. 1. Colony of *Didemnum aurantiacum;* natural size.

Fig. 2. A small portion of the surface layer of test of *Didemnum aurantiacum;* enlarged.

Fig. 3. One of the branchial apertures seen from the surface; magnified (S., 1 inch).

Fig. 4. Section of the test in its deeper part; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. One of the branchial apertures seen from the inside, showing sphincter muscle, and three lobes; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Spicules from the test; *a* shows the most common form; highly magnified (enlarged from S., $\frac{1}{4}$ inch).

Fig. 7. A small portion of the wall of the large testis, with the vas deferens coiled round it; magnified (S., 1 inch).

Fig. 8. One of the large tailed larvæ of *Didemnum aurantiacum;* magnified (S., 1 inch).

Fig. 9. Colony of *Leptoclinum rubicundum;* natural size.

Fig. 10. Part of the outer layer of the colony, including the anterior parts of the Ascidiozooids, seen from the inside; magnified (S., 1 inch).

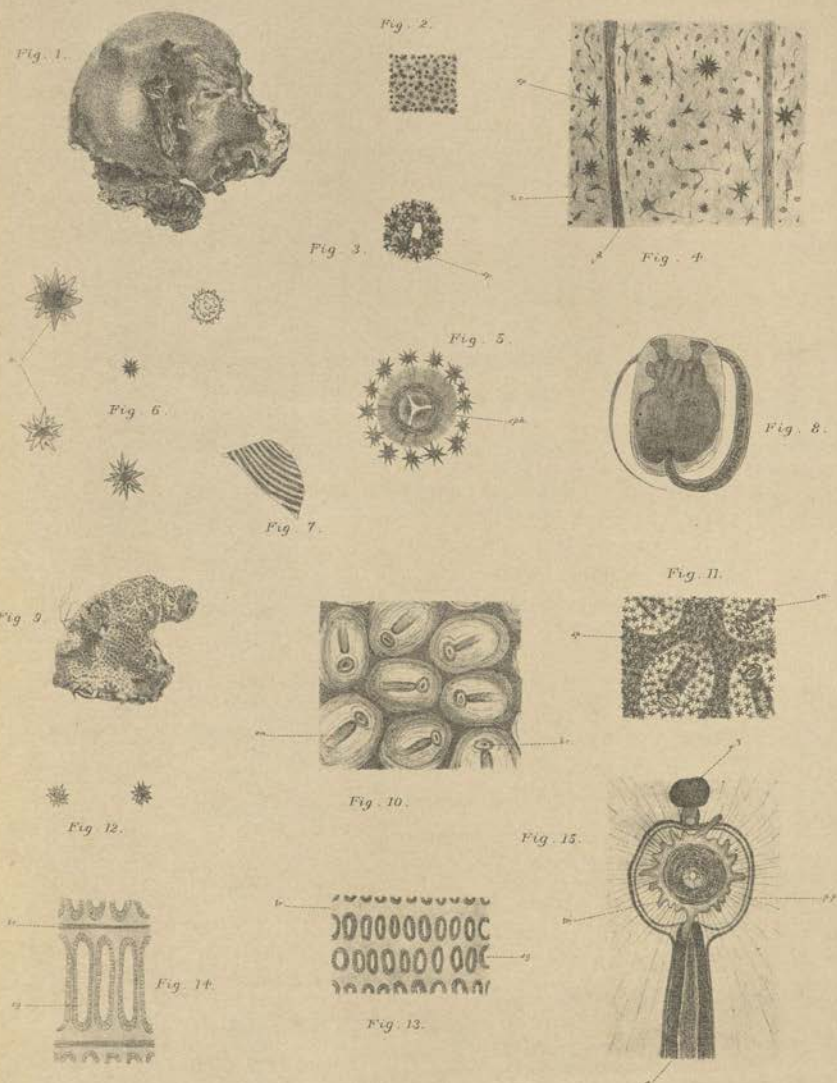
Fig. 11. Part of the surface of the colony, seen from the outside; magnified (S., 1 inch, enlarged).

Fig. 12. Spicules from the test of *Leptoclinum rubicundum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Part of the branchial sac of a young Ascidiozooid of *Leptoclinum rubicundum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Part of the branchial sac of an adult Ascidiozooid of *Leptoclinum rubicundum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. The anterior end of an Ascidiozooid, seen from the inside, and showing endostyle, nerve ganglion, peripharyngeal band, tentacles, sphincter, branchialaperture, &c.; highly magnified (S., $\frac{1}{4}$ inch).



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T. Dobb & Co. lith. Lpool.

FIGS. 1-8. DIDEMNUM AURANTIACUM, n. sp.
FIGS. 9-15. LEPTOCLINUM RUBICUNDUM, n. sp.

PLATE XXXIV.

PLATE XXXIV.

Figs. 1–5. *Didemnum savignii*, n. sp.
Figs. 6, 7. *Didemnum* (*?*) *inerme*, n. sp.
Figs. 8–13. *Leptoclinum speciosum*, var. *asperum*, nov.
Fig. 14. *Leptoclinum annectens*, n. sp.

bl. Bladder cell.	*œ.* Œsophagus.	*t.c.* Test cells.
br. Branchial aperture.	*p.c.* Mass of pigment cells.	*th.* Thorax.
en. Endostyle.	*r.* Rectum.	*t.m.* Test matrix.
i. Intestine.	*sg.* Stigmata of branchial sac.	*tr.* Transverse vessel of branchial sac.
m.f. Muscle fibres.	*sp.* Calcareous spicule in test.	*v.ap.* Vascular appendage.
o. Ovum.	*st.* Stomach.	*v.d.* Vas deferens.

Fig. 1. Colony of *Didemnum savignii;* natural size.

Fig. 2. Ascidiozooid of *Didemnum savignii*, seen from right side; magnified (S., 1 inch).

Fig. 3. Part of section of test of *Didemnum savignii;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 4. Three spicules from test of *Didemnum savignii*, showing different forms; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Part of branchial sac of *Didemnum savignii;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Colony of *Didemnum inerme;* natural size.

Fig. 7. Section of test of *Didemnum inerme;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 8. Large colony of *Leptoclinum speciosum*, var. *asperum;* natural size.

Fig. 9. Vertical section of colony of *Leptoclinum speciosum*, var. *asperum*, showing the arrangement of the spicules in the test and the structure of the Ascidiozooids, &c.; magnified (S., 1 inch).

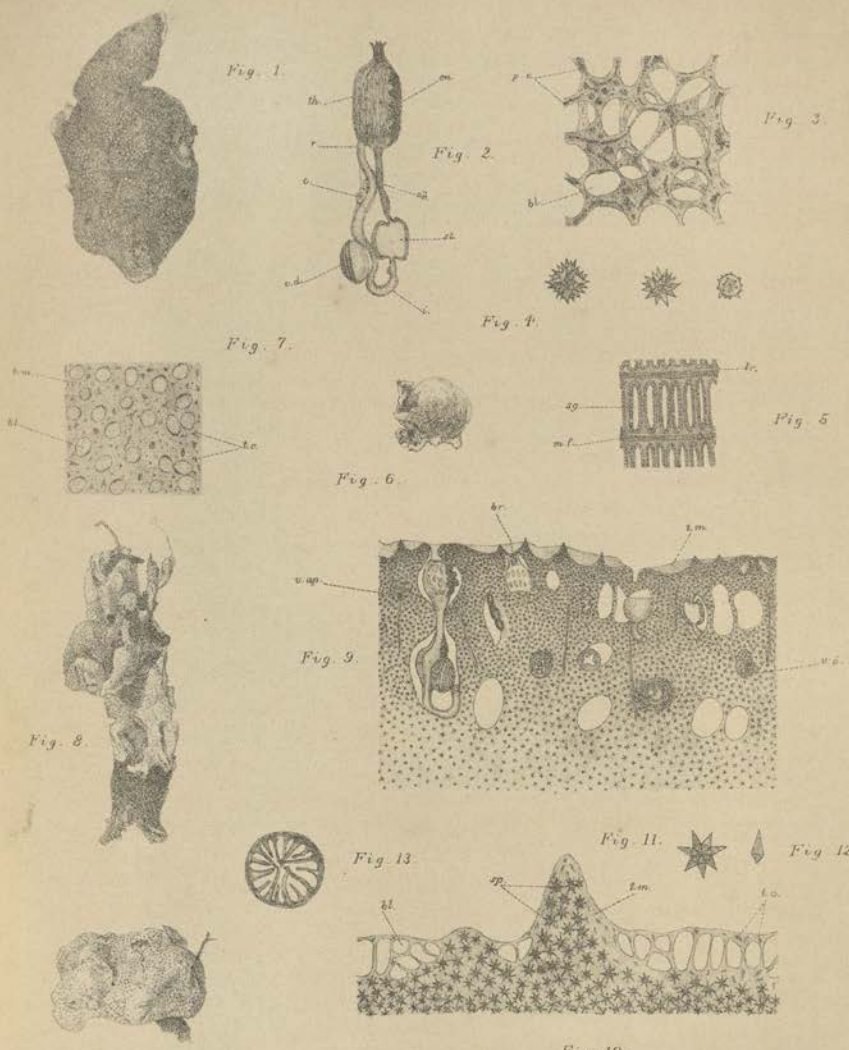
Fig. 10. Section of superficial layer of colony of *Leptoclinum speciosum*, var. *asperum*, showing structure of test and arrangement of spicules; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Diagrammatic optical section of spicule from test of *Leptoclinum speciosum*, var. *asperum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 12. Diagram of wedge-shaped element of spicule; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 13. Circle of tentacles of *Leptoclinum speciosum*, var. *asperum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Colony of *Leptoclinum annectens;* natural size.



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T. Dale & Co. Lith. Lpool.

FIGS 1-5, DIDEMNUM SAVIGNII, n. sp.
FIGS 6-7, DIDEMNUM (?) INERME, n. sp.
FIGS 8-13, LEPTOCLINUM SPECIOSUM, var. ASPERUM, nov.
FIG. 14, LEPTOCLINUM ANNECTENS, n. sp.

PLATE XXXV.

PLATE XXXV.

Figs. 1–10. *Leptoclinum tonga*, n. sp.
Figs. 11–14. *Leptoclinum albidum*, var. *grande*, nov.

ad. Adhering process of test.	*sp.* Calcareous spicule in test.	*t.m.* Test matrix.
br. Branchial aperture.	*sph.* Sphincter.	*tn. tn'.* Tentacles.
l.s. Lower surface of colony.	*t.c.* Test cell.	

Fig. 1. Colony of *Leptoclinum tonga;* natural size.

Fig. 2. Part of a section, showing the anterior end of an Ascidiozooid cut vertically; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of a section of the lower surface of the colony, showing the adhering prolongations of test; magnified (S., 1 inch).

Fig. 4. Spicules from the test; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Small part of a section of the test, after decalcification in hydrochloric acid, stained in aniline blue; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Small part of a section of the test, after decalcification in a solution of carbon dioxide for eighteen hours, stained in aniline blue; highly magnified (S., $\frac{1}{4}$ inch). 1 indicates the boundary of the vacuole, and 2 the membrane of the spicule.

Fig. 7. Small part of a section of the test, after partial decalcification in hydrochloric acid, stained in eosine; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. A spicule teased out and stained with aniline blue; highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Another spicule similarly treated; highly magnified (Z., $\frac{1}{12}$).

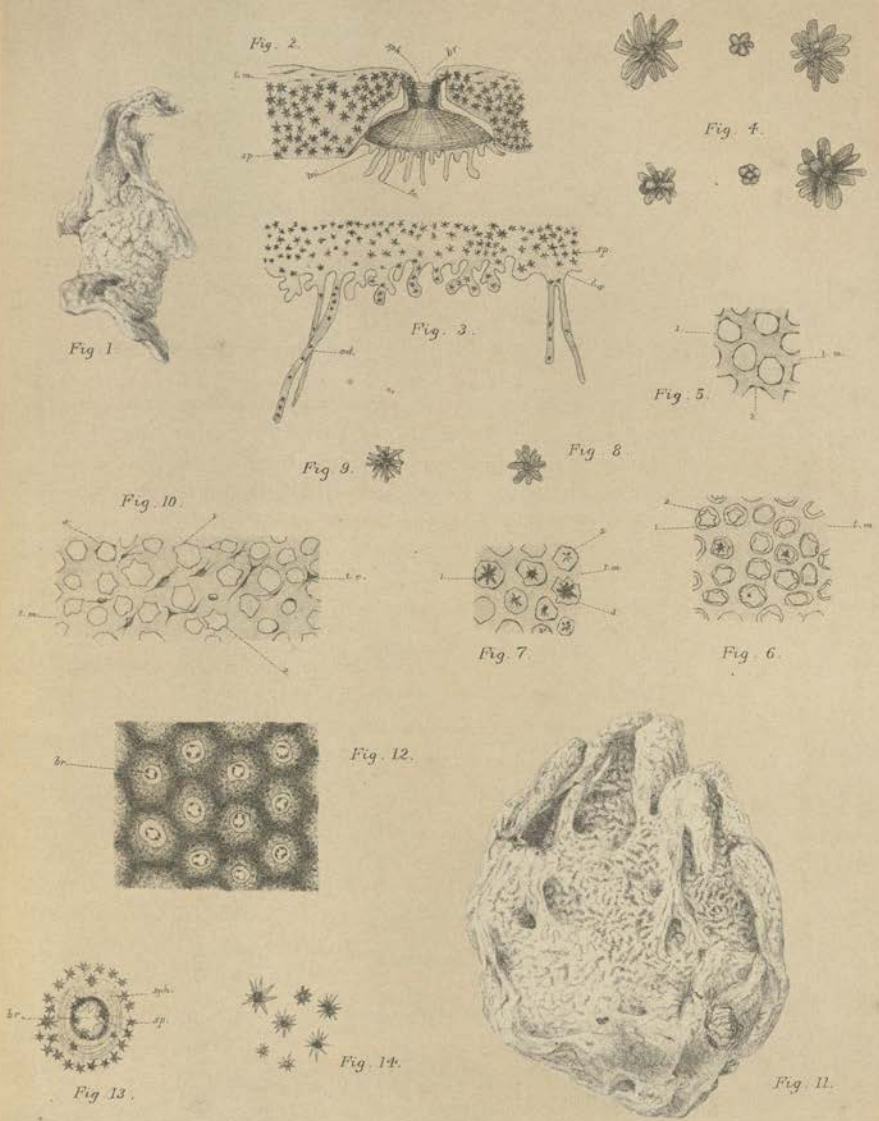
Fig. 10. Small part of a section of the test, after decalcification in a solution of carbon dioxide for twenty-four hours, stained in aniline blue; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Colony of *Leptoclinum albidum*, var. *grande;* natural size.

Fig. 12. Part of the surface of *Leptoclinum albidum*, var. *grande;* magnified (S., 1 inch).

Fig. 13. The branchial aperture of an Ascidiozooid of *Leptoclinum albidum*, var. *grande;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Spicules from the test of *Leptoclinum albidum*, var. *grande;* highly magnified (S., $\frac{1}{6}$ inch).



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T. Dobb & Co. Lith. Lpool.

FIGS. 1-10. LEPTOCLINUM TONGA, n. sp.
FIGS. 11-14. LEPTOCLINUM ALBIDUM, var. GRANDE, nov.

PLATE XXXVI.

PLATE XXXVI.

Figs. 1–8. *Leptoclinum speciosum*, n. sp.
Fig. 9. *Leptoclinum speciosum*, var. *asperum*, nov.

bl. Bladder cell.
br. Branchial aperture.
cl. Cloacal aperture.
en. Endostyle.
l.v. Fine longitudinal vessels of branchial sac.
m.b. Muscle band in mantle.
r. Rectum.
sp. Calcareous spicule in test.
st. Stomach.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
t.v. Spermatic vesicles.
v. Vessel in test.
v.d. Vas deferens.

Fig. 1. Large colony of *Leptoclinum speciosum;* natural size.

Fig. 2. Part of the upper surface of *Leptoclinum speciosum;* slightly enlarged.

Fig. 3. Vertical section through a thickened part of a colony of *Leptoclinum speciosum*, showing Ascidiozooids; magnified (S., 1 inch, reduced).

Fig. 4. Part of a section through the middle of the test of *Leptoclinum speciosum;* highly magnified (S., $\frac{1}{4}$ inch).

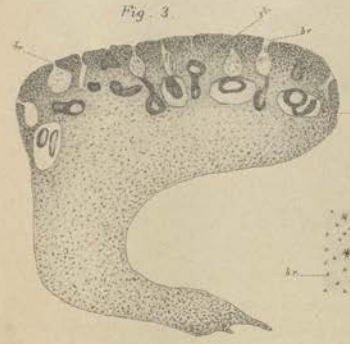
Fig. 5. Surface view of part of ectoderm of *Leptoclinum speciosum;* highly magnified (S., $\frac{1}{4}$ inch, enlarged).

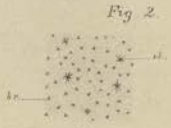
Fig. 6. Part of the mantle of *Leptoclinum speciosum;* highly magnified (S., $\frac{1}{4}$ inch).

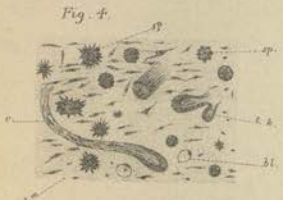
Fig. 7. Section through the testis and vas deferens of *Leptoclinum speciosum*; highly magnified (S., $\frac{1}{4}$ inch).

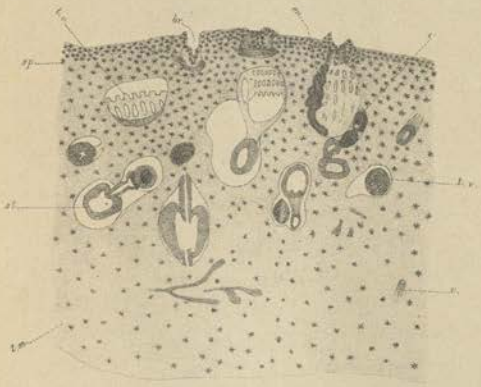
Fig. 8. Part of a vertical section through the colony of *Leptoclinum speciosum*, showing structure of the Ascidiozooids, &c.; magnified (S., 1 inch).

Fig. 9. Four colonies of *Leptoclinum speciosum*, var. *asperum*; natural size.









W. A. Herdman, del.

T. Dobb & Co. Lith. Lpool.

FIGS 1-8. LEPTOCLINUM SPECIOSUM, n. sp.

FIG. 9. LEPTOCLINUM SPECIOSUM var ASPERUM, nov.

PLATE XXXVII.

PLATE XXXVII.

Figs. 1–8. *Cœlocormus huxleyi*, n. sp.
Figs. 9–14. *Leptoclinum moseleyi*, n. sp.

a. Anus.	*œ.* Œsophagus.	*t.* Test.
en. Endostyle.	*sg.* Stigmata of branchial sac.	*t.c.* Test cells.
i. Intestine.	*sp*, *sp'*, *sp''*. Spicules in test.	*t.m.* Test matrix.
l.s. Lower surface of colony.	*sph.* Sphincter.	*tr.* Transverse vessel of branchial sac.
m. Mantle.	*st.* Stomach.	*u.s.* Upper surface of colony.
m.b. Muscle band in mantle.		

Fig. 1. Colony of *Cœlocormus huxleyi*, from the side; natural size.

Fig. 2. Colony of *Cœlocormus huxleyi*, from the edge, showing the terminal opening; natural size.

Fig. 3. Section of part of colony of *Cœlocormus huxleyi*; slightly enlarged.

Fig. 4. Spicules from test of *Cœlocormus huxleyi*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of mantle of *Cœlocormus huxleyi*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Part of branchial sac of *Cœlocormus huxleyi*; magnified (S., 1 inch).

Fig. 7. Small part of branchial sac of *Cœlocormus huxleyi*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Alimentary canal of *Cœlocormus huxleyi*; magnified (S., 1 inch).

Fig. 9. Colony of *Leptoclinum moseleyi*, from upper surface; natural size.

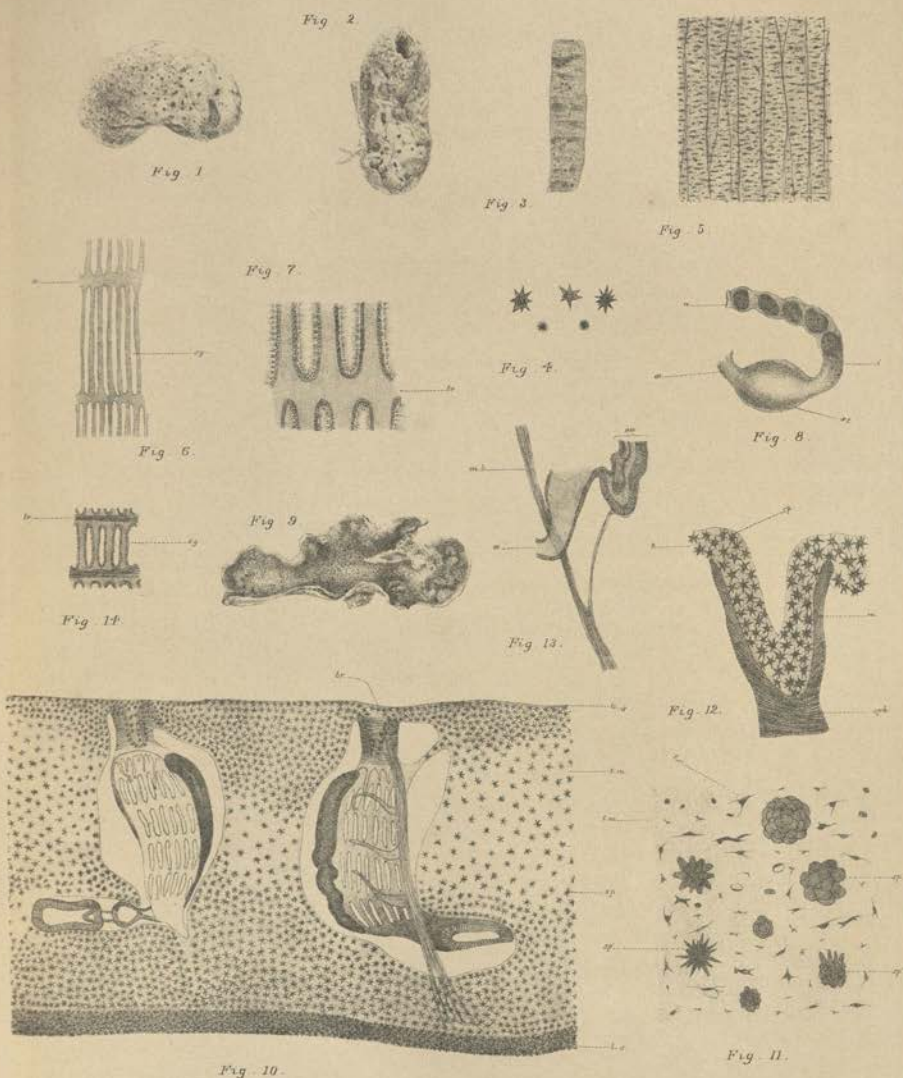
Fig. 10. Vertical section of colony of *Leptoclinum moseleyi*, showing arrangement of spicules in test, and structure of Ascidiozooids; magnified (S., 1 inch).

Fig. 11. Part of section of test of *Leptoclinum moseleyi*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 12. Vertical section of branchial aperture of *Leptoclinum moseleyi*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 13. Œsophageal region of Ascidiozooid of *Leptoclinum moseleyi*, showing arrangement of retractor muscles; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Part of branchial sac of *Leptoclinum moseleyi*; highly magnified (S., $\frac{1}{4}$ inch).



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J. Dobb's Cº Lith. Lond.

FIGS 1-8, CŒLOCORMUS HUXLEYI, n. sp.
FIGS 9-14, LEPTOCLINUM MOSELEYI, n. sp.

PLATE XXXVIII.

PLATE XXXVIII.

Figs. 1–4. *Cœlocormus huxleyi*, n. sp.
Figs. 5–9. *Leptoclinum annectens*, n. sp.
Figs. 10–13. *Leptoclinum neglectum*, n. sp.
Figs. 14–18. *Leptoclinum subflavum*, n. sp.
Figs. 19–22. *Leptoclinum (?) jacksoni*, n. sp.

br. Branchial aperture.
cl. Cloacal aperture.
d.t. Dorsal tubercle.
en. Endostyle.
inf. Infundibulum.
m.f. Muscle fibres.
n.g. Nerve ganglion.
n.gl. Neural gland.
p.c. Pigment cell.
p.p. Peripharyngeal band.
sg. Stigmata of branchial sac.
sp. Spicules.
sph. Sphincter muscle.
t.c. Small cells in the test.
tr. Transverse vessel of branchial sac.
tn, tn'. Large and small tentacles.
u.s. Lower surface of colony.
v.ap. Vascular appendage.

Fig. 1. Diagrammatic vertical section of colony of *Cœlocormus huxleyi;* natural size.

Fig. 2. Part of the surface of *Cœlocormus huxleyi*, showing pentagonal branchial apertures; enlarged.

Fig. 3. One of the branchial apertures of *Cœlocormus huxleyi*, showing lobes; magnified (S., 1 inch).

Fig. 4. The nerve ganglion, neural gland, and dorsal tubercle of *Cœlocormus huxleyi;* highly magnified (Z., $\frac{1}{12}$).

Fig. 5. Part of the surface of the colony of *Leptoclinum annectens*, showing the branchial and common cloacal apertures; enlarged.

Fig. 6. Branchial aperture of *Leptoclinum annectens*, showing lobes, sphincter, and spicules; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Semi-diagrammatic view of the anterior dorsal part of the Ascidiozooid of *Leptoclinum annectens*, showing nerve ganglion, dorsal tubercle, &c.; magnified (S., $\frac{1}{4}$ inch, reduced).

Fig. 8. Part of the branchial sac of *Leptoclinum annectens;* magnified (S., 1 inch).

Fig. 9. The ventral part of the anterior end of the Ascidiozooid of *Leptoclinum annectens*, showing tentacles, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Colony of *Leptoclinum neglectum;* natural size.

Fig. 11. Part of the surface of *Leptoclinum neglectum*, showing Ascidiozooids; magnified (S., 1 inch).

Fig. 12. Branchial aperture of Ascidiozooid of *Leptoclinum neglectum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Two spicules from the test of *Leptoclinum neglectum;* more highly magnified (S., $\frac{1}{8}$ inch).

Fig. 14. Colony of *Leptoclinum subflavum;* natural size.

Fig. 15. Ascidiozooid of *Leptoclinum subflavum*, seen from right side; magnified (S., 1 inch).

Fig. 16. Large flat spicule from test of *Leptoclinum subflavum;* magnified (S., 1 inch).

Fig. 17. Part of the branchial sac of *Leptoclinum subflavum;* highly magnified (S., $\frac{1}{8}$ inch).

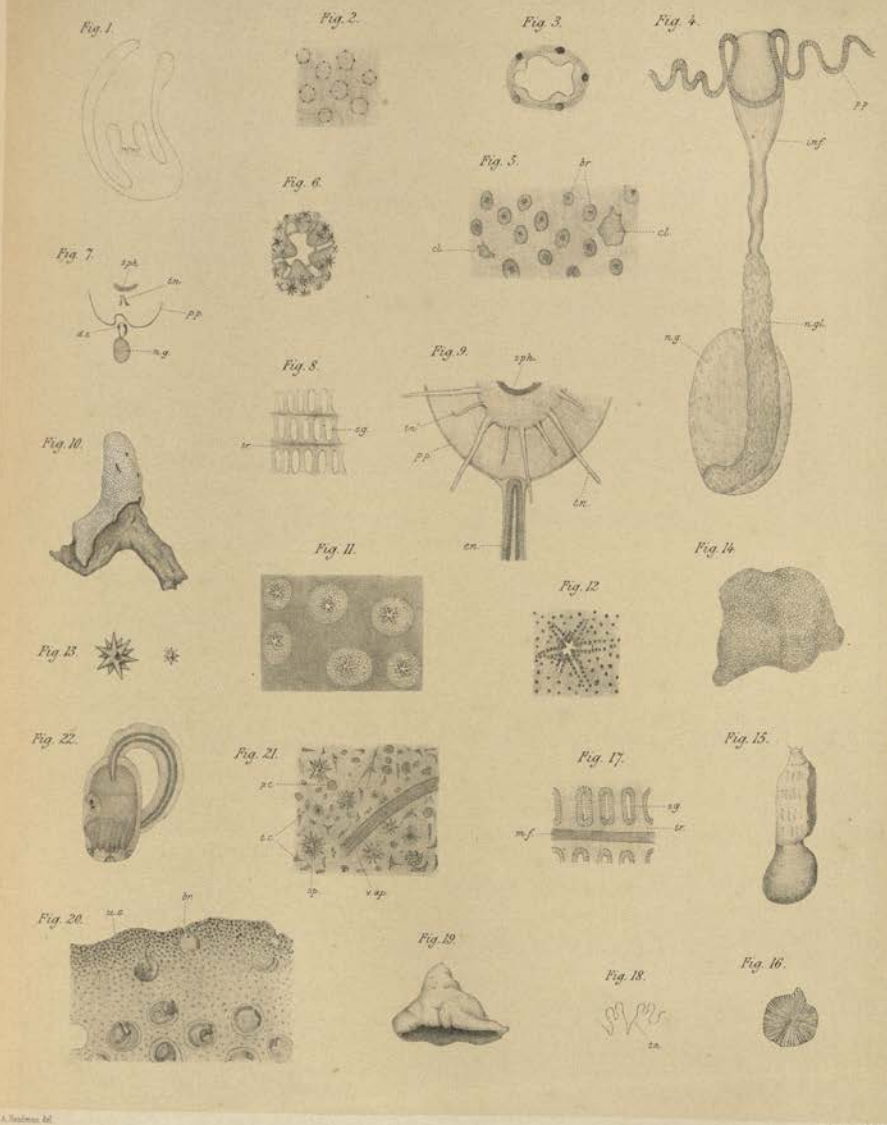
Fig. 18. Some of the tentacles of *Leptoclinum subflavum;* highly magnified (S., $\frac{1}{4}$ inch). *tn.* indicates the dorsal tentacle of the series.

Fig. 19. Colony of *Leptoclinum (?) jacksoni;* natural size.

Fig. 20. Part of a transverse section through the colony of *Leptoclinum (?) jacksoni*, showing the arrangement of spicules and Ascidiozooids in the test; magnified (S., 1 inch).

Fig. 21. Part of a section through the test of *Leptoclinum (?) jacksoni;* highly magnified (S., $\frac{1}{8}$ inch).

Fig. 22. Tailed larva of *Leptoclinum (?) jacksoni;* magnified (S., 1 inch).



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FIGS 1-4, CŒLOCORMUS HUXLEYI, n. sp. FIGS 5-9, LEPTOCLINUM ANNECTENS, n. sp.
FIGS 10-13, LEPTOCLINUM NEGLECTUM, n. sp. FIGS 14-18, LEPTOCLINUM SUBFLAVUM, n. sp.
FIGS 19-22, LEPTOCLINUM (?) JACKSONI, n. sp.

PLATE XXXIX.

PLATE XXXIX.

Figs. 1–7. *Leptoclinum japonicum*, n. sp.
Figs. 8–11. *Leptoclinum tenue*, n. sp.
Figs. 12–15. *Leptoclinum edwardsi*, n. sp.
Figs. 16–20. *Leptoclinum propinquum*, n. sp.

bl. Bladder cell.
br. Branchial aperture.
en. Endostyle.
sg. Stigmata of branchial sac.
sg.c. Ciliated cells bounding stigmata.
t.c. Test cells.
tr. Transverse vessel of branchial sac.
v.d. Vas deferens.

Fig. 1. Colony of *Leptoclinum japonicum;* natural size.

Fig. 2. Colony of *Leptoclinum japonicum*, showing base; natural size.

Fig. 3. Section through test of *Leptoclinum japonicum*, stained in aniline blue; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Branchial sac of *Leptoclinum japonicum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Branchial aperture of *Leptoclinum japonicum*, showing arrangement of spicules; magnified (S., 1 inch, enlarged).

Fig. 6. Spicules from test of *Leptoclinum japonicum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of testis and vas deferens of *Leptoclinum japonicum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 8. Colony of *Leptoclinum tenue;* natural size.

Fig. 9. Part of colony of *Leptoclinum tenue;* slightly enlarged.

Fig. 10. Part of surface of *Leptoclinum tenue*, showing arrangement of Ascidiozooids and spicules; magnified (S., 1 inch).

Fig. 11. Spicules from test of *Leptoclinum tenue;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Colony of *Leptoclinum edwardsi;* natural size.

Fig. 13. Another colony of *Leptoclinum edwardsi;* natural size.

Fig. 14. Branchial sac of *Leptoclinum edwardsi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Spicules from test of *Leptoclinum edwardsi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. Colony of *Leptoclinum propinquum;* natural size.

Fig. 17. Part of surface of *Leptoclinum propinquum;* magnified (S., 1 inch).

Fig. 18. Ascidiozooid of *Leptoclinum propinquum*, seen from left side; magnified (S., 1 inch).

Fig. 19. Part of branchial sac of *Leptoclinum propinquum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 20. Spicules from test of *Leptoclinum propinquum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

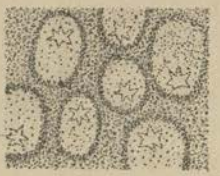
Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 19.

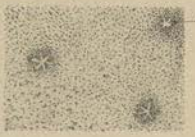
Fig. 17.

Fig. 16.

Fig. 18.

Fig. 20.

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FIGS 1-7. LEPTOCLINUM JAPONICUM, n. sp.
FIGS 8-11 LEPTOCLINUM TENUE, n. sp.
FIGS 12-15. LEPTOCLINUM EDWARDSI, n. sp.
FIGS 16-20. LEPTOCLINUM PROPINQUUM, n. sp.

PLATE XL.

PLATE XL.

Figs. 1, 2. *Leptoclinum tenue*, var. *magnizooidium*, nov.
Figs. 3–5. *Leptoclinum tenue*, n. sp.
Figs. 6–9. *Leptoclinum jeffreysi*, n. sp.
Figs. 10–15. *Leptoclinum albidum*, var. *luteolum*, Verrill.

bl. Bladder cell. *br.* Branchial aperture. | *l.s.* Lower surface of colony. *t.m.* Test matrix. | *u.s.* Upper surface of colony.

Fig. 1. Colony of *Leptoclinum tenue*, var. *magnizooidium*; natural size.

Fig. 2. Spicule from test of *Leptoclinum tenue*, var. *magnizooidium*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Colony of *Leptoclinum tenue*, from North Atlantic (H.M.S. "Porcupine"); natural size.

Fig. 4. Spicules of the ordinary size from test of *Leptoclinum tenue*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Very large spicule from test of *Leptoclinum tenue*; highly magnified (S., $\frac{1}{4}$ inch). Figures 2, 4, and 5 are drawn to the same scale. Spicules of sizes intermediate between those shown in figures 4 and 5 are also present.

Fig. 6. Colony of *Leptoclinum jeffreysi*; natural size.

Fig. 7. Vertical section through colony of *Leptoclinum jeffreysi*; magnified (S., 1 inch).

Fig. 8. Part of section through lower part of colony of *Leptoclinum jeffreysi*, showing structure of test; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Spicule from test of *Leptoclinum jeffreysi*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Colony of *Leptoclinum albidum*, var. *luteolum*; natural size.

Fig. 11. Another colony of *Leptoclinum albidum*, var. *luteolum*; natural size.

Fig. 12. Spicules from test of *Leptoclinum albidum*, var. *luteolum*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Larva of *Leptoclinum albidum*, var. *luteolum*, showing well-developed branchial sac co-existing with larval tail, adhering organs, &c.; magnified (S., 1 inch).

Fig. 14. Part of test of tailed larva of *Leptoclinum albidum*, var. *luteolum*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Adhering organ of tailed larva of *Leptoclinum albidum*, var. *luteolum*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4.

Fig. 2.

Fig. 1.

Fig. 3.

Fig. 5.

Fig. 6.

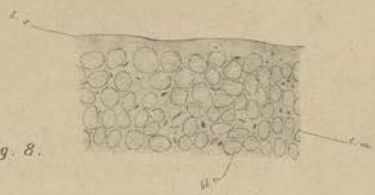

Fig. 8.

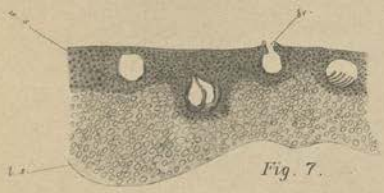

Fig. 7.

Fig. 9.

Fig. 15.

Fig. 13.

Fig. 14.

Fig. 11.

Fig. 10.

Fig. 12.

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FIGS 1-2 LEPTOCLINUM TENUE, var MAGNIZOCIDIUM, nov. FIGS 6-9 LEPTOCLINUM JEFFREYSI. n. sp.
FIGS 3-5 LEPTOCLINUM TENUE, n. sp. FIGS 10-15 LEPTOCLINUM ALBIDUM var LUTEOLUM. Verrill.

PLATE XLI.

PLATE XLI.

Figs. 1–4. *Leptoclinum carpenteri*, n. sp.
Figs. 1, 5–7. *Leptoclinum thomsoni*, n. sp.

br. Branchial aperture.
en. Endostyle.
l.v. Fine longitudinal vessels of branchial sac.
m.b. Muscle band in mantle.
œ. Œsophagus.
r. Rectum.
sg. Stigmata of branchial sac.
sp. Calcareous spicule in test.
st. Stomach.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v. Vessel in the test.

Fig. 1. Colonies of—A. *Leptoclinum thomsoni*, and B. *Leptoclinum carpenteri*; natural size.

Fig. 2. Part of a vertical section through the colony of *Leptoclinum carpenteri*, showing arrangement of spicules and structure of Ascidiozooids; magnified (S., 1 inch).

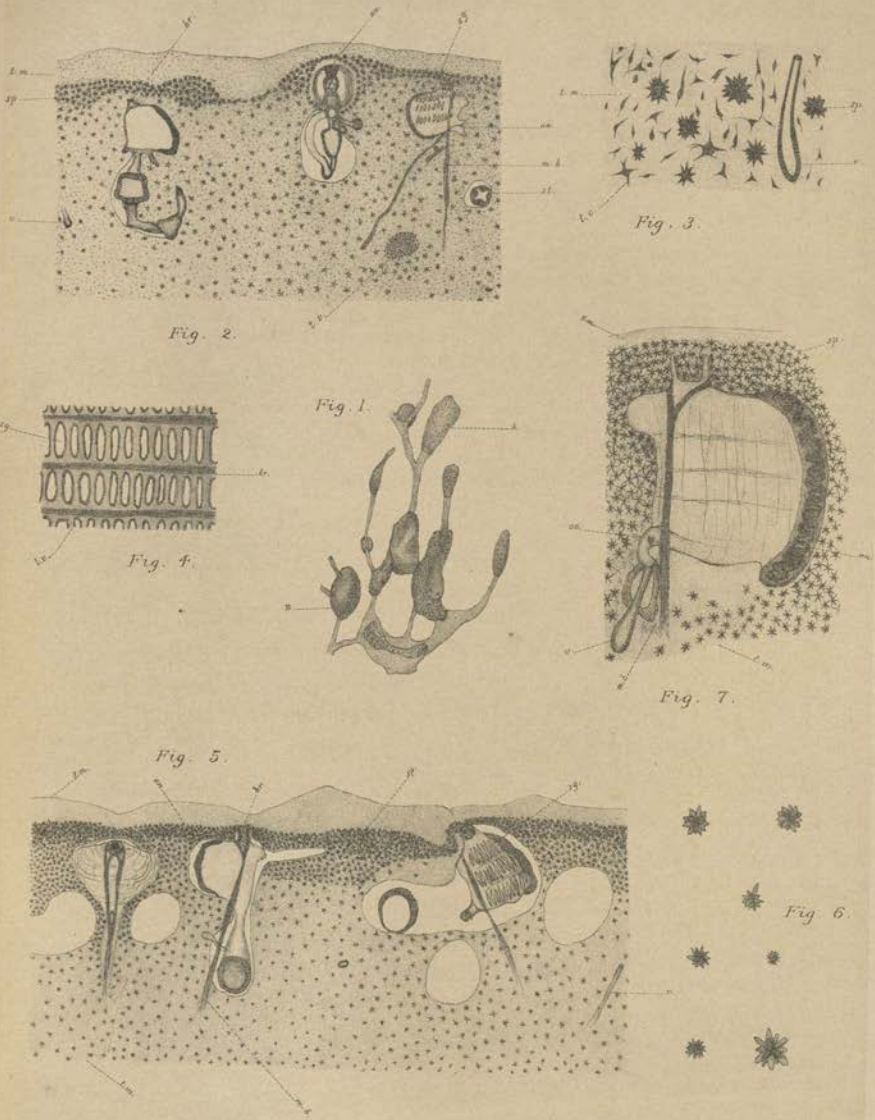
Fig. 3. Section through test of *Leptoclinum carpenteri*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of branchial sac of *Leptoclinum carpenteri*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of a vertical section through the colony of *Leptoclinum thomsoni*, showing arrangement of spicules and structure of Ascidiozooids; magnified (S., 1 inch).

Fig. 6. Spicules from test of *Leptoclinum thomsoni*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of a vertical section through upper part of colony of *Leptoclinum thomsoni*, showing the thoracic region of an Ascidiozooid and the neighbouring test; highly magnified (S., $\frac{1}{4}$ inch).



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T. Dobb & Co. Lith. Lpool.

FIGS. 1-4. LEPTOCLINUM CARPENTERI, n. sp.
FIGS. 1, 5-7 LEPTOCLINUM THOMSONI, n. sp.

PLATE XLII.

PLATE XLII.

Figs. 1–4. *Diplosoma macdonaldi*, n. sp.
Figs. 5–16. *Diplosomoides molle*, n. sp.

bl. Bladder cell.
br. Branchial aperture.
br.s., *br.s'.* Branchial sac.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
i., *i'.* Intestine.
l. Languet.
l.v. Fine longitudinal vessels of branchial sac.
m.f. Muscle fibres.
œ. Œsophagus.
p.p. Peripharyngeal band.
sg. Stigmata of branchial sac.
st, *st'.* Stomach.
t.c. Test cells.
tn, *tn'.* Tentacles.
tr. Transverse vessel of branchial sac.
v.ap. Vascular appendage.

Fig. 1. Colony of *Diplosoma macdonaldi*, attached to a Hydroid Zoophyte along with a Polyzoon and a Sponge ; natural size.

Fig. 2. Part of colony of *Diplosoma macdonaldi*, showing Ascidiozooids ; magnified (S., 1 inch).

Fig. 3. Part of test of *Diplosoma macdonaldi ;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of branchial sac of *Diplosoma macdonaldi ;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Colony of *Diplosomoides molle ;* natural size.

Fig. 6. Part of colony of *Diplosomoides molle*, showing Ascidiozooids ; magnified (S., 1 inch, reduced).

Fig. 7. Ascidiozooid of *Diplosomoides molle*, seen from right side, showing gemmation (*br.s'*, *st'*, *i'*); magnified (S., 1 inch).

Fig. 8. Another Ascidiozooid of *Diplosomides molle*, seen from right side, showing gemmation ; magnified (S., 1 inch).

Fig. 9. Ascidiozooid of *Diplosomoides molle*, seen from left side ; magnified (S., 1 inch).

Fig. 10. Vascular appendage of *Diplosomoides molle ;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Optical section of bulb on vascular appendage ; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Spicules from test of *Diplosomoides molle ;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Anterior end of Ascidiozooid seen from branchial sac, showing tentacles, &c. ; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Part of branchial sac of *Diplosomoides molle ;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Small part of dorsal edge of branchial sac of a young Ascidiozooid of *Diplosomoides molle*, showing languets ; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. Dorsal languets of an adult Ascidiozooid of *Diplosomoides molle ;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 1.

Fig. 2.

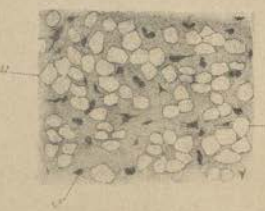


Fig. 3.

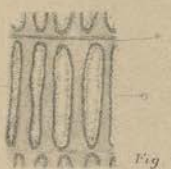


Fig. 4.

Fig. 5.

Fig. 6.

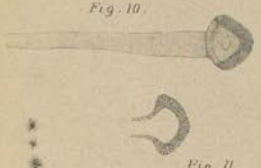


Fig. 10.

Fig. 11.

Fig. 12.

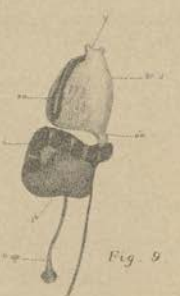


Fig. 9.

Fig. 8.

Fig. 7.

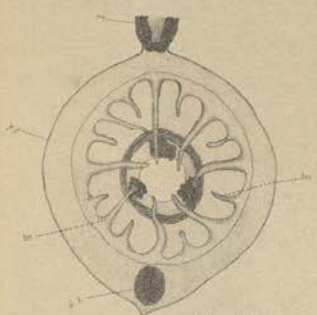


Fig. 13.

Fig. 14.

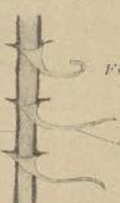


Fig. 16.

Fig. 15.

FIGS 1-4, DIPLOSOMA MACDONALDI, n. sp.
FIGS 5-16, DIPLOSOMOIDES MOLLE, n. sp.

PLATE XLIII.

PLATE XLIII.

Figs. 1–10. *Goodsiria placenta*, n. sp.

a. Anus.	*i.* Intestine.	*r.* Rectum.
at. Atrial aperture.	*i.l.* Internal longitudinal bar of branchial sac.	*sg.* Stigmata of branchial sac.
at.tn. Atrial tentacles.	*m.* Mantle.	*st.* Stomach.
br.f. Fold in branchial sac.	*n.g.* Nerve ganglion.	*tn, tn'.* Tentacles.
d.l. Dorsal lamina.	*œ.* Œsophagus.	*tr.* Transverse vessel of branchial sac.
h.t. Glandular tubules on wall of intestine.	*p.p.* Peripharyngeal band.	*ves.* Vesicle into which the glandular tubules open.

Fig. 1. Colony of *Goodsiria placenta*; natural size.

Fig. 2. Transverse section of colony of *Goodsiria placenta*; natural size.

Fig. 3. Part of the test of *Goodsiria placenta*, showing vessels; magnified (S., 1 inch).

Fig. 4. Part of branchial sac of *Goodsiria placenta*, showing folds and dorsal lamina; magnified (S., 1 inch).

Fig. 5. Alimentary canal of *Goodsiria placenta*; slightly enlarged.

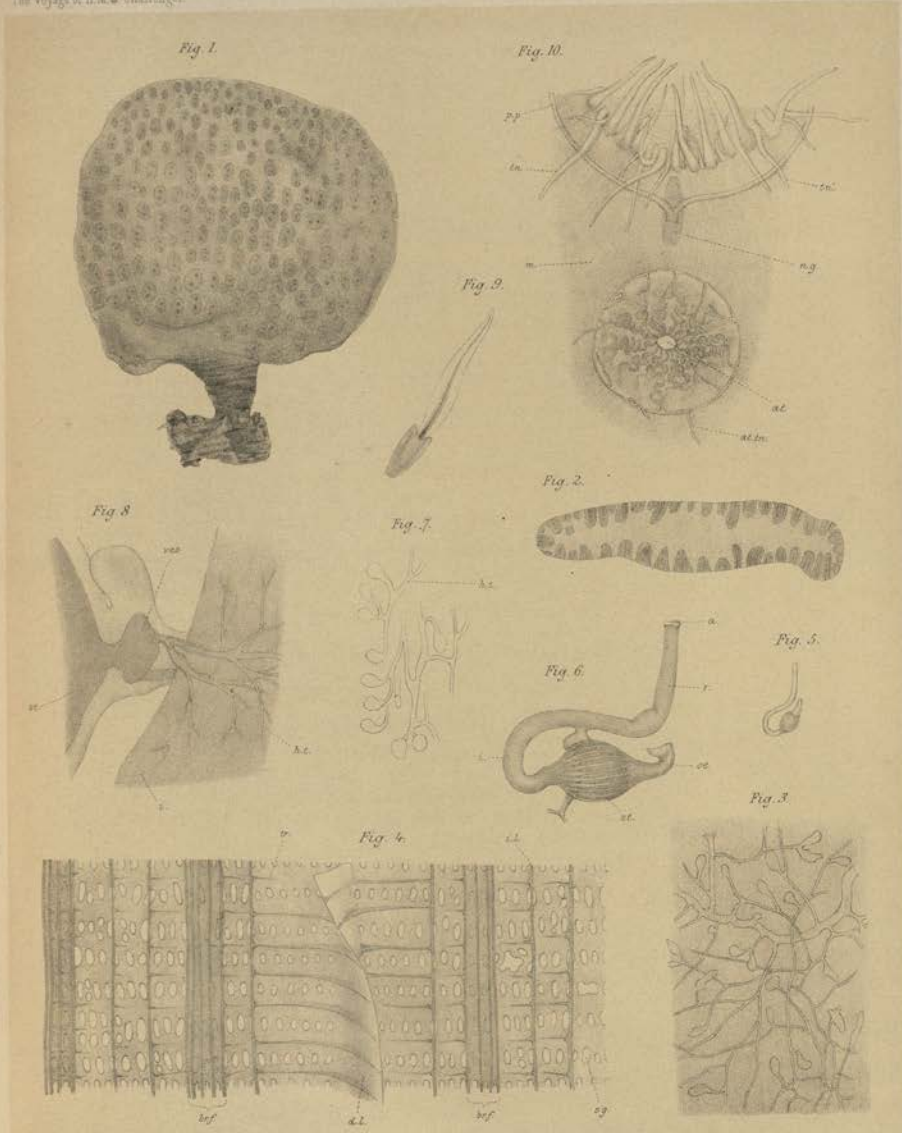
Fig. 6. Alimentary canal of another Ascidiozooid of *Goodsiria placenta*; magnified (S., 1 inch, reduced).

Fig. 7. Glandular tubules from wall of intestine; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Part of intestine and stomach showing glandular tubules opening into a vesicle which communicates with the stomach; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Tailed larva of *Goodsiria placenta*; magnified (S., 1 inch, reduced).

Fig. 10. Anterior part of Ascidiozooid of *Goodsiria placenta*, showing branchial and atrial tentacles, &c.; magnified (S., 1 inch).



W. A. Bardman del.

F. Huth, Lith. Edin.

GOODSIRIA PLACENTA, n. sp.

PLATE XLIV.

PLATE XLIV.

Figs. 1–3. *Goodsiria pedunculata*, n. sp.
Figs. 4, 8–10. *Goodsiria placenta*, n. sp.
Figs. 5–7. *Goodsiria placenta*, var. *fusca*, nov.

b.c. Pigmented cells in mantle.
br.f., *br.f'.* Folds in branchial sac.
b.v. Blood-vessels in wall of stomach.
ep. Ciliated epithelium in interior of stomach.
fd. Fold in wall of stomach.
i.l. Internal longitudinal bar of branchial sac.
m. Mantle.
o. Ovum.
o.d. Oviduct.
sg. Stigmata of branchial sac.
t. Test.
tr. Transverse vessels of branchial sac.
t.v. Spermatic vesicles.
ty. Typhlosole or large fold in stomach wall.
v.d. Vas deferens.

Fig. 1. Colony of *Goodsiria pedunculata*; natural size.

Fig. 2. Part of branchial sac of *Goodsiria pedunculata*, seen from the interior; magnified (S., 1 inch).

Fig. 3. Transverse section of the stomach of *Goodsiria pedunculata*, showing the numerous large folds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Longitudinal vertical section through one of the polycarps of *Goodsiria placenta*; magnified (S., 1 inch).

Fig. 5. Colony of *Goodsiria placenta*, var *fusca*; natural size.

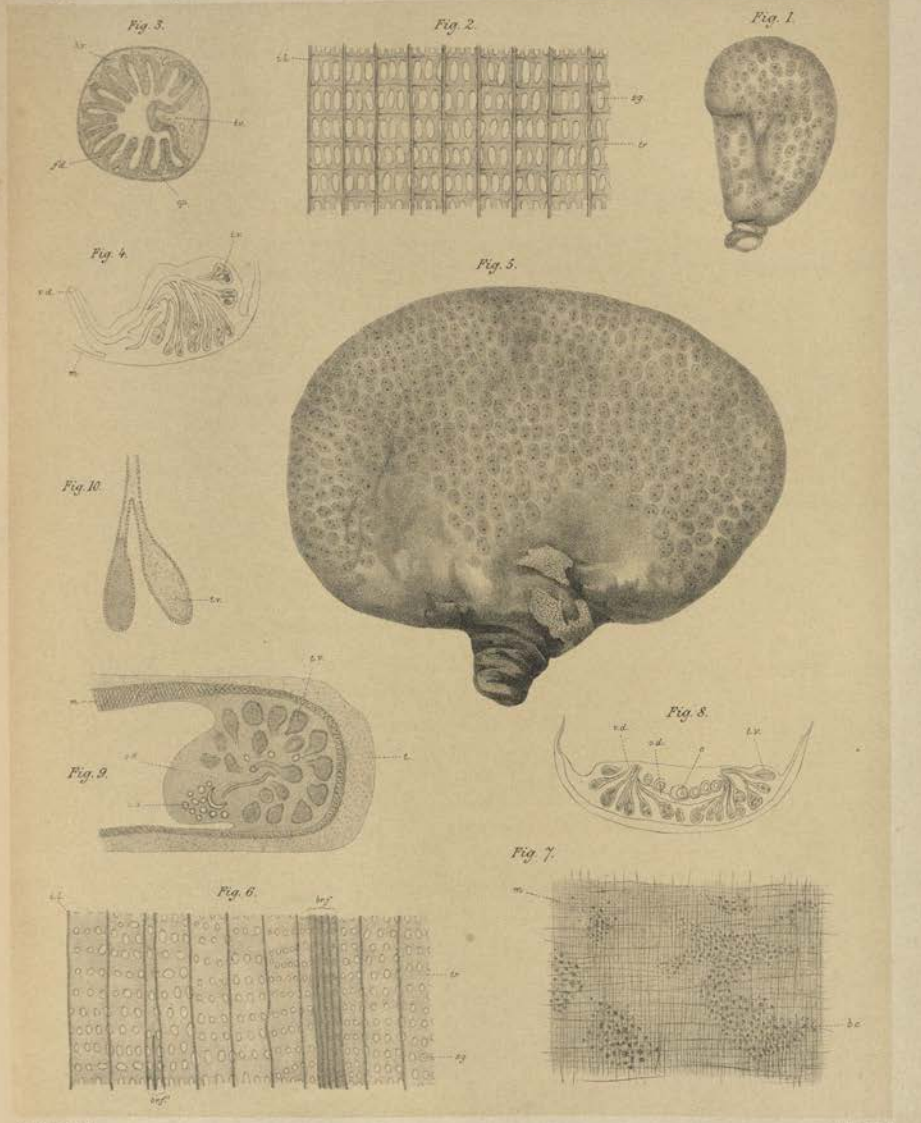
Fig. 6. Part of the branchial sac of *Goodsiria placenta*, var. *fusca*, showing one complete and one rudimentary fold; magnified (S., 1 inch).

Fig. 7. Part of the mantle of *Goodsiria placenta*, var. *fusca*, showing arrangement of muscle bands and pigment cells; magnified (S., 1 inch).

Fig. 8. Transverse section of polycarp of *Goodsiria placenta*; magnified (S., 1 inch).

Fig. 9. Oblique section through a polycarp of *Goodsiria placenta*, showing its relations to the mantle and test; magnified (S., 1 inch).

Fig. 10. Two spermatic vesicles from the polycarp of *Goodsiria placenta*; highly magnified (S., $\frac{1}{4}$ inch).



W. A. Herdman del.

F. Bath, Lith. Edin.

FIGS 1-3, GOODSIRIA PEDUNCULATA, n. sp. FIGS 4, 8-10, GOODSIRIA PLACENTA, n. sp.
FIGS 5-7, GOODSIRIA PLACENTA var. FUSCA, nov.

PLATE XLV.

PLATE XLV.

Goodsiria coccinea, Cunningham.

a. Anus.
at. Atrial aperture.
br. Branchial aperture.
b.v. Blood-vessel.
cc. Ectoderm.
en. Endostyle.
end. Endoderm.
i. Intestine.
i.l. Internal longitudinal bar of branchial sac.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
mcs. Mesoderm.
o. Ovum.
o.d. Oviduct.
œ. Œsophagus.
p.br.c. Peribranchial cavity.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
tr'. Smaller transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v. Vessel in test.
v.d. Vas deferens.

Fig. 1. Part of large colony of *Goodsiria coccinea;* natural size.

Fig. 2. Several small colonies of *Goodsiria coccinea;* natural size.

Fig. 3. Anterior end of Ascidiozooid, showing apertures; enlarged.

Fig. 4. Part of test of *Goodsiria coccinea,* showing vessels; magnified (S., 1 inch).

Fig. 5. Part of branchial sac of *Goodsiria coccinea,* seen from interior; magnified (S., 1 inch).

Fig. 6. Part of branchial sac of young Ascidiozooid, seen from interior; magnified (S., 1 inch).

Fig. 7. Part of branchial sac of adult Ascidiozooid, seen from interior; magnified (S., 1 inch).

Fig. 8. Small part of branchial sac, seen from the interior; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Vascular appendage attached to posterior end of Ascidiozooid; magnified (S., 1 inch).

Fig. 10. Transverse section of vascular appendage in test; magnified (S., 1 inch).

Fig. 11. Small part of transverse section of vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Origin of vascular appendage from posterior end of Ascidiozooid; magnified (S., 1 inch).

Fig. 13. Section through mantle and polycarps of *Goodsiria coccinea;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Polycarp of *Goodsiria coccinea,* dissected out; highly magnified (S., $\frac{1}{4}$ inch).

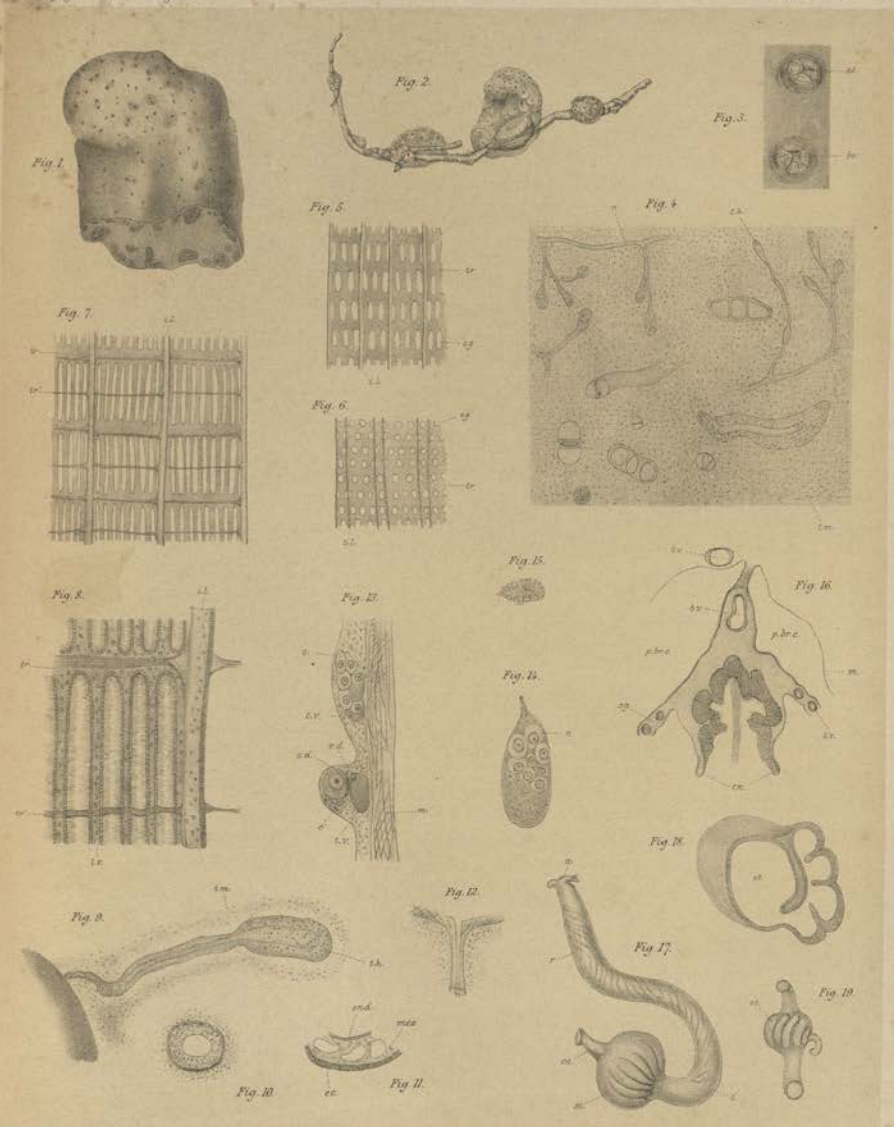
Fig. 15. Endocarp of *Goodsiria coccinea,* detached from mantle; magnified (S., 1 inch).

Fig. 16. Transverse section through endostyle and neighbouring structures; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 17. Alimentary canal of *Goodsiria coccinea*; enlarged.

Fig. 18. Section across stomach of *Goodsiria coccinea,* showing folds in the interior; magnified (S., 1 inch).

Fig. 19. Stomach of another Ascidiozooid of *Goodsiria coccinea,* showing the cæcum; enlarged.



W.A. Bordman del.

F. Huth, Lith. Edin.

GOODSIRIA COCCINEA, Cunningham.

PLATE XLVI.

PLATE XLVI.

Figs. 1–8. *Chorizocormus reticulatus*, n. sp.
Figs. 9–14. *Synstyela incrustans*, n. sp.

d.t. Dorsal tubercle.
en.c. Endocarp.
g. Polycarp.
i.l. Internal longitudinal bar of branchial sac.
ov. Ova.
p.p. Peripharyngeal band.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tn, tn'. Tentacles.
tr, tr'. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v. Vessel in test.

Fig. 1. Large colony of *Chorizocormus reticulatus;* natural size.

Fig. 2. Small colony of *Chorizocormus reticulatus;* natural size.

Fig. 3. Small colony of *Chorizocormus reticulatus;* natural size.

Fig. 4. Another small colony of *Chorizocormus reticulatus;* natural size.

Fig. 5. Part of stolon of *Chorizocormus reticulatus*, showing vessels; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Part of branchial sac of *Chorizocormus reticulatus*, seen from the interior; magnified (S., 1 inch).

Fig. 7. Dorsal part of anterior end of Ascidiozooid of *Chorizocormus reticulatus*, showing tentacles, dorsal tubercle, &c; magnified (S., 1 inch).

Fig. 8. Part of mantle of *Chorizocormus reticulatus*, seen from the inner surface, showing attached female polycarps (*g.*); magnified (S., 1 inch).

Fig. 9. Colony of *Synstyela incrustans;* natural size.

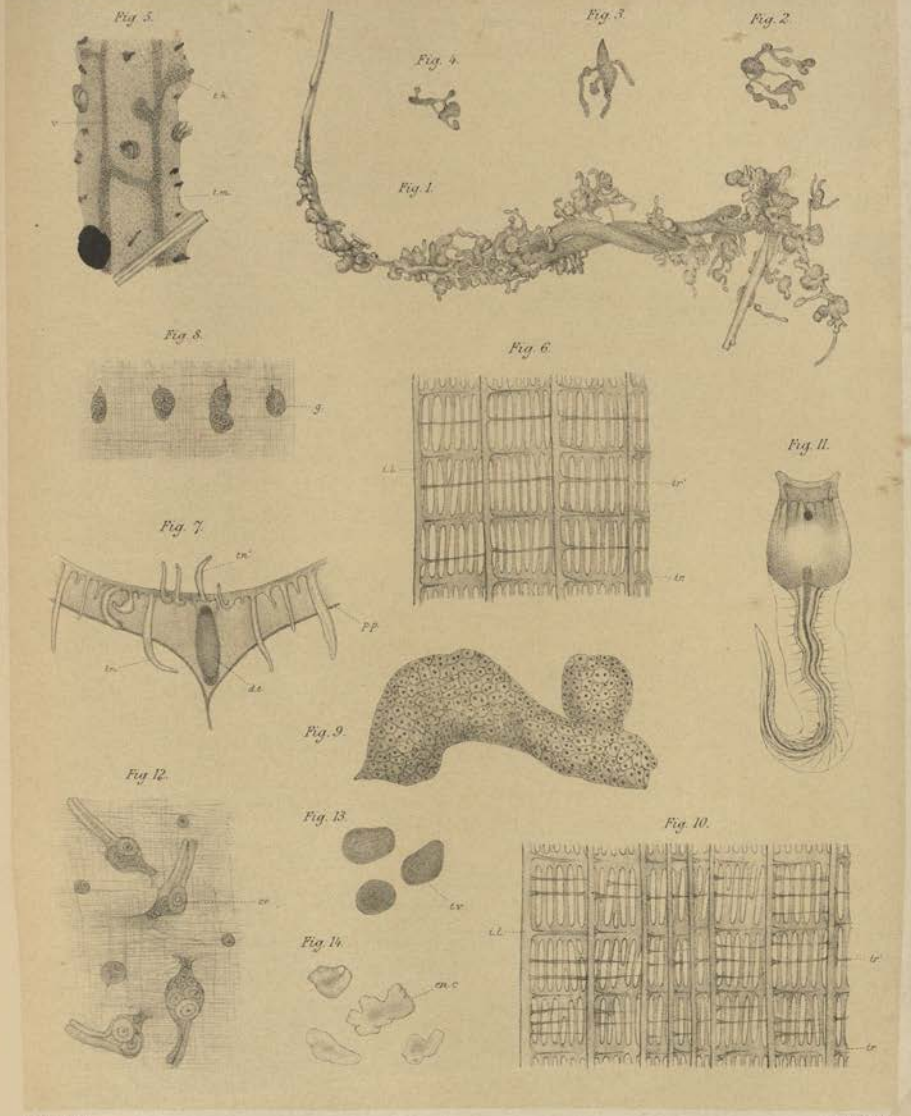
Fig. 10. Part of branchial sac of *Synstyela incrustans*, seen from the interior; magnified (S., 1 inch).

Fig. 11. Larva of *Synstyela incrustans*, showing structure of tail; magnified (S., 1 inch).

Fig. 12. Part of mantle of *Synstyela incrustans*, seen from the inner surface, showing female polycarps (*ov.*) in various stages of development; magnified (S., 1 inch).

Fig. 13. Three male polycarps (*t.v.*) detached from mantle; magnified (S., 1 inch).

Fig. 14. Four endocarps (*en.c.*) detached from mantle; magnified (S., 1 inch).



W. A. Newman, del.

F. Huth, Lith. Edinr.

FIGS 1-8, CHORIZOCORMUS RETICULATUS, n. sp.

FIGS 9-14, SYNSTYELA INCRUSTANS, n. sp.

PLATE XLVII.

PLATE XLVII.

Figs. 1, 2. *Molgula carpenteri*, n. sp.
Figs. 3–5. *Polycarpa aspera*, n. sp.
Fig. 6. *Bathyoncus discoideus*, n. sp.
Figs. 7–10. *Bathyoncus minutus*, n. sp.
Fig. 11. *Ascidia scabra* (?), O. F. Müller.

at. Atrial aperture.	*m.b.* Muscle bands.	*tn, tn'.* Large and small tentacles.
br. Branchial aperture.	*œ.* Œsophagus.	*tr, tr', tr''.* Transverse vessels of branchial sac.
g. Reproductive organs.	*sg.* Stigmata of branchial sac.	
i. Intestine.	*st.* Stomach.	

Fig. 1. Specimen of *Molgula carpenteri*, seen from side; natural size.

Fig. 2. Part of the branchial sac of *Molgula carpenteri*, seen from the inside; magnified (S., 1 inch).

Fig. 3. Specimen of *Polycarpa aspera;* natural size.

Fig. 4. Part of the branchial sac of *Polycarpa aspera*, seen from inside; magnified (S., 1 inch).

Fig. 5. Tentacles of *Polycarpa aspera;* magnified (S., 1 inch).

Fig. 6. Diagram showing the course of the alimentary canal in *Bathyoncus discoideus;* natural size.

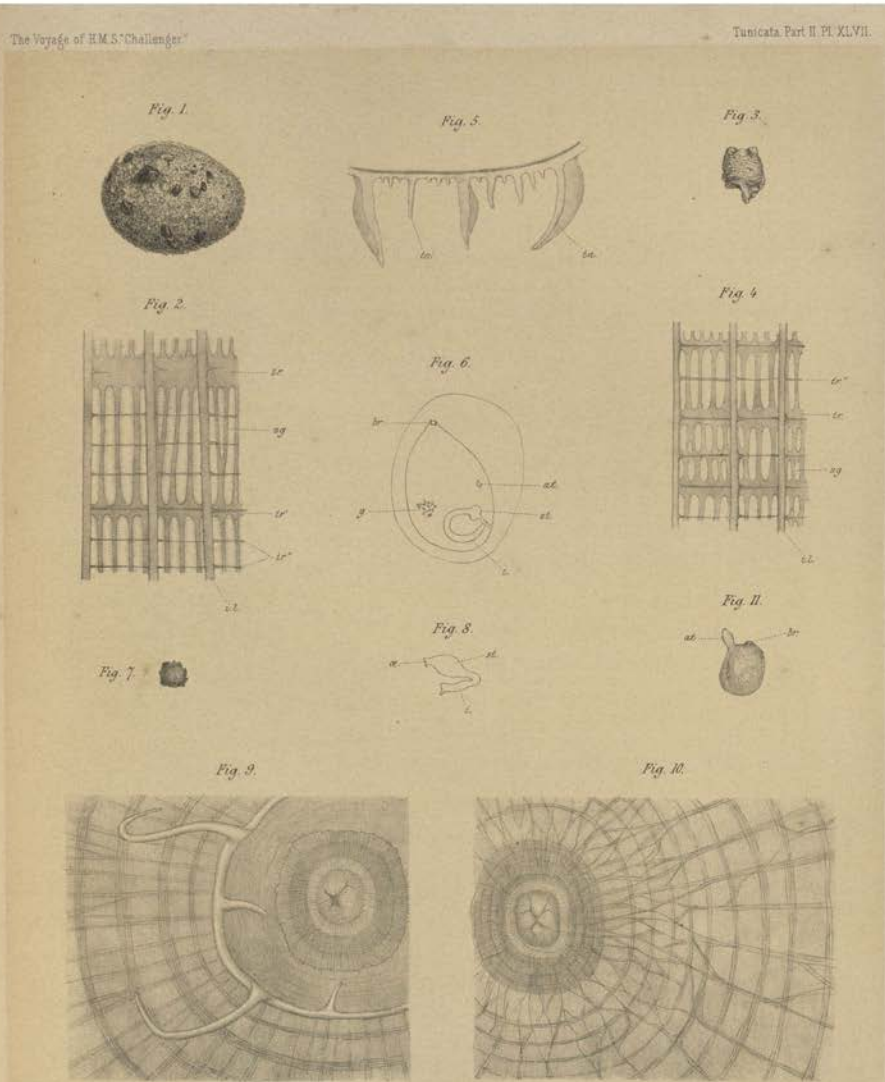
Fig. 7. Specimen of *Bathyoncus minutus;* natural size.

Fig. 8. Alimentary canal of *Bathyoncus minutus;* magnified (S., 1 inch, reduced).

Fig. 9. Branchial aperture, &c., of *Bathyoncus minutus*, seen from the inside, showing tentacles, muscle bands, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Atrial aperture, &c., of *Bathyoncus minutus*, seen from the inside, showing muscle bands; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Specimen of *Ascidia scabra* (?), O. F. Müller, with test removed, seen from right hand side, showing enlarged atrial siphon; natural size.



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FIGS 1 & 2, MOLGULA CARPENTERI, n. sp. FIGS 3-5, POLYCARPA ASPERA, n. sp.
FIG. 6, BATHYONCUS DISCOIDEUS, n. sp. FIGS 7-10, BATHYONCUS MINUTUS n. sp.
FIG. 11, ASCIDIA SCABRA, O. F. Müller. (?)

PLATE XLVIII.

PLATE XLVIII.

Figs. 1–4. *Culeolus willemœsi*, n. sp.
Figs. 5–11. *Bathyoncus discoideus*, n. sp.

br.f. Longitudinal fold in branchial sac. | *i.l.* Internal longitudinal bar of branchial sac. | *sp.* Spicule. *tr.* Transverse vessel of branchial sac.

Fig. 1. *Culeolus willemœsi;* natural size.

Fig. 2. Part of the branchial sac of *Culeolus willemœsi;* magnified (S., 1 inch).

Fig. 3. Branchial aperture of *Culeolus willemœsi;* enlarged.

Fig. 4. One of the tentacles of *Culeolus willemœsi;* magnified (S., 1 inch).

Fig. 5. *Bathyoncus discoideus;* natural size.

Fig. 6. Part of the mantle of *Bathyoncus discoideus;* magnified (S., 1 inch).

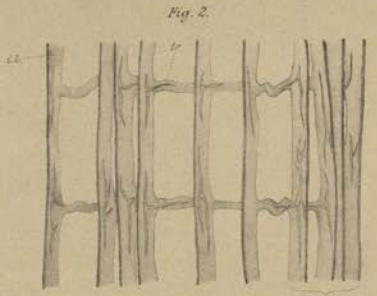
Fig. 7. One of the tentacles of *Bathyoncus discoideus;* magnified (S., 1 inch).

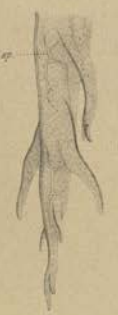
Fig. 8. Part of the branchial sac of *Bathyoncus discoideus;* magnified (S., 1 inch).

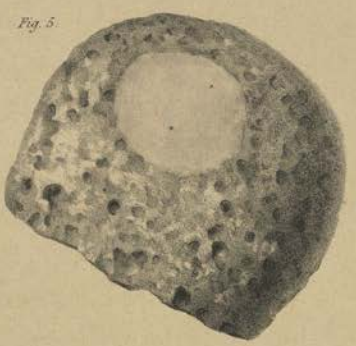
Fig. 9. One of the large folds from the branchial sac of *Bathyoncus discoideus*; magnified (S., 1 inch).

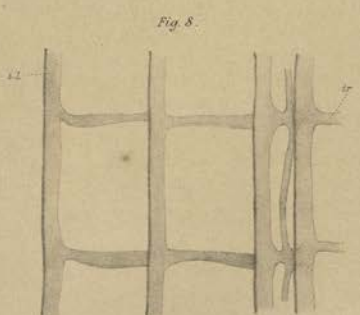
Fig. 10. Part of one of the internal longitudinal bars from the branchial sac of *Bathyoncus discoideus*, showing the spicules, &c.; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 11. One of the groups of reproductive organs of *Bathyoncus discoideus*, dissected off from the mantle; enlarged.









FIGS 1-4, CULEOLUS WILLEMOESI, n. sp. FIGS 5-11, BATHYONCUS DISCOIDEUS, n. sp.

PLATE XLIX.

PLATE XLIX.

Figs. 1–3. *Polycarpa bassi*, n. sp.
Figs. 4–6. *Polycarpa longisiphonica* (?), Herdman.
Figs. 7, 8. *Styela pusilla*, n. sp.
Figs. 9, 10. *Styela radicosa* (?), Herdman.
Figs. 11–13. *Ciona aspera*, n. sp.

br.f. Longitudinal fold in branchial sac. *i.l.* Internal longitudinal bars of branchial sac. | *p.* Papillæ on the internal longitudinal bars. | *sg.* Stigmata. *tr, tr'.* Large and small transverse vessels.

Fig. 1. *Polycarpa bassi;* natural size.

Fig. 2. Part of branchial sac of *Polycarpa bassi*, seen from the inside; magnified (S., 1 inch).

Fig. 3. Dissection of *Polycarpa bassi*, showing branchial sac and course of alimentary canal; natural size.

Fig. 4. *Polycarpa longisiphonica* (?); natural size.

Fig. 5. Part of the branchial sac of *Polycarpa longisiphonica* (?), seen from the inside; magnified (S., 1 inch).

Fig. 6. Part of the ectoderm of *Polycarpa longisiphonica* (?); highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. *Styela pusilla;* natural size.

Fig. 8. Part of the branchial sac of *Styela pusilla*, seen from the inside; magnified (S., 1 inch).

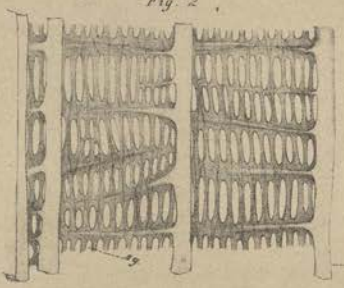
Fig. 9. *Styela radicosa* (?), from right side; natural size.

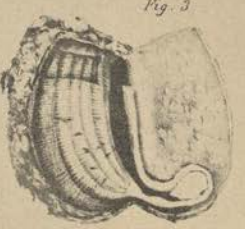
Fig. 10. Part of the branchial sac of *Styela radicosa* (?), seen from inside; magnified (S., 1 inch).

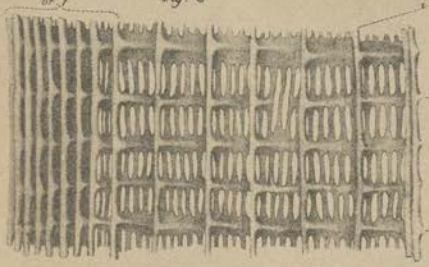
Fig. 11. *Ciona aspera;* natural size.

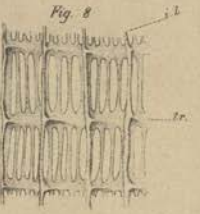
Fig. 12. *Ciona aspera*, with test removed; slightly enlarged.

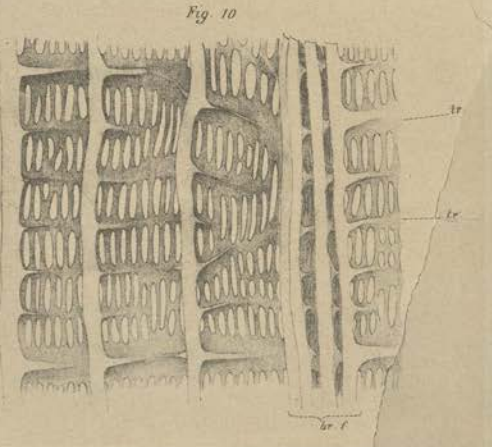
Fig. 13. Part of the branchial sac of *Ciona aspera*, seen from the inside; magnified (S., 1 inch).











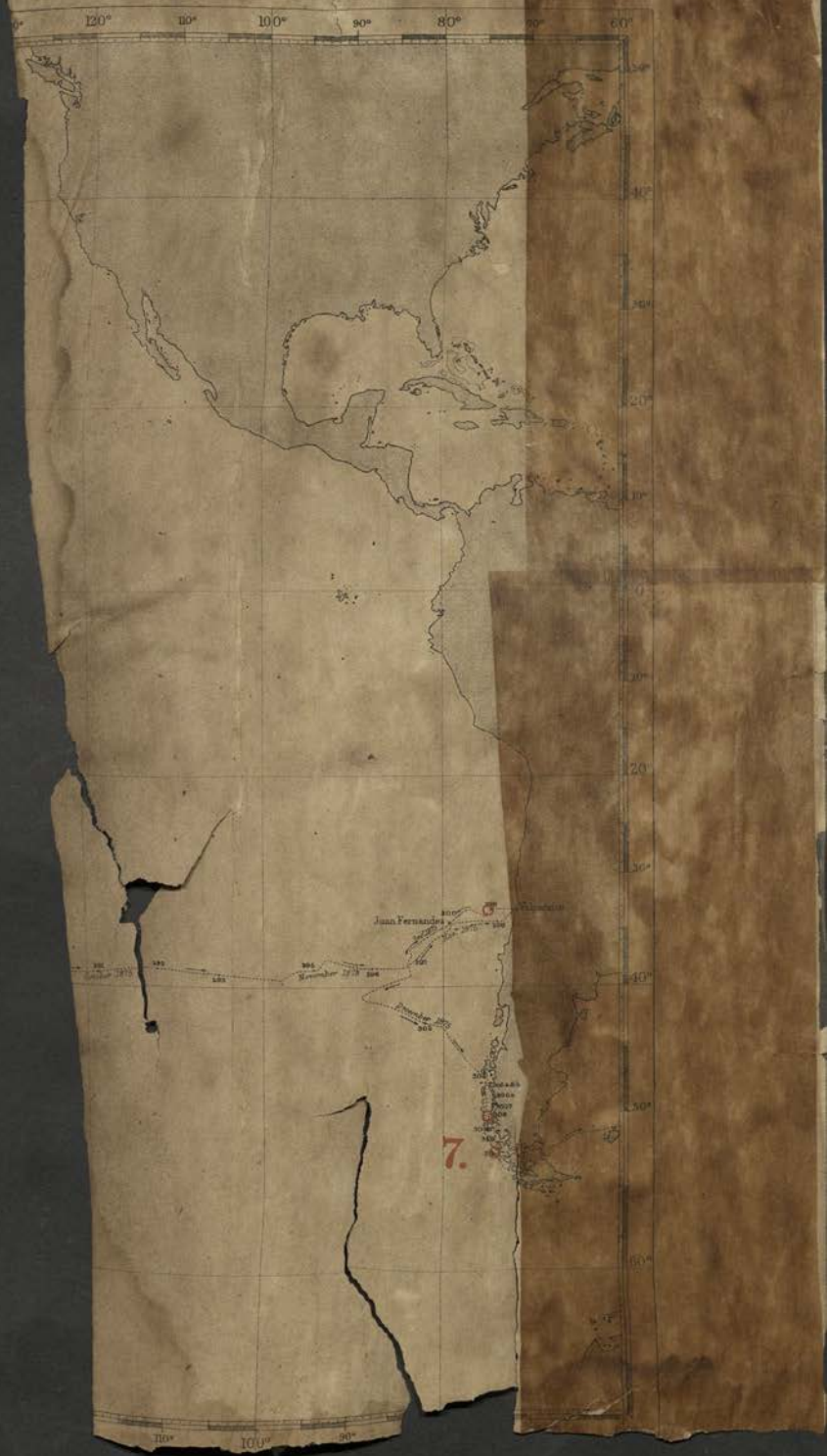
FIGS 1-3 POLYCARPA BASSI, n.sp. FIGS 4-6 POLYCARPA LONGISIPHONICA, Herdman (?)

FIGS 7-8 STYELA PUSILLA, n.sp. FIGS 9-10 STYELA RADICOSA, Herdman (?)

FIGS 11-13 CIONA ASPERA, n.sp.

1.
2.
7.
TRACK OF
H.M.S. CHALLE
Dec. 1872 to May
red circles indicate

3.
4.
5.


120°
110°
100°
90°
80°
60°
40°
20°
0°
20°
30°
40°
50°
60°
Juan Fernandez
7.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the HOLOTHURIOIDEA dredged by H.M.S. Challenger during the Years 1873-76. By HJALMAR THÉEL. Part II.

INTRODUCTION.

IN this second part of my work on the HOLOTHURIOIDEA I have not limited my labours to a description of those forms of the Apoda and Pedata which were brought home by the Challenger Expedition, but have added a short exposition of all shallow-water forms hitherto known. It was considered that such a monograph was highly desirable. It should not be forgotten, however, that the difficulties of a monograph are very great, especially in the case of the Holothurioidea, and that larger and smaller gaps must necessarily occur because of the frequent imperfection in the descriptions of many authors. Besides the Challenger collections, I have had at my disposition for comparison the very rich collection of the State Zoological Museum in Stockholm, kindly placed in my hands by Professor S. Lovén, a pretty large collection of tropical forms belonging to the Godeffroy Museum, and divers forms, partly types, from the Mediterranean and Mauritius, for the use of which I feel extremely obliged to Dr. E. von Marenzeller and Professor Karl Möbius.

The examination of the vast harvest brought home by the Challenger Expedition from different regions of the world, from the shore as well as from the abysses of the ocean, shows clearly that those Holothurids which live in the deep sea have two different derivations. The great majority are Elasipoda, which cannot be derived from the present shallow-water fauna, but must have originated from a past type that certainly bore another stamp. On the other hand, so far as can be judged from the results of the

expeditions hitherto made, the remaining Holothurids met with in the great depths are comparatively few both in species and individuals, and unmistakably show the closest relation to the present shallow-water fauna; so that while the Elasipoda have retired towards the abysses an infinitely long time ago, the latter have emigrated only at a comparatively much later period. The *Cucumariæ* and several other present shallow-water forms that have descended as far down as 2000 fathoms are veritable *Cucumariæ*, &c., that, in spite of their highly altered mode of life, have not yet had time to acquire any noteworthy deviations from the typical character of the genera in question. Such an emigration, which can be traced in the case of divers groups of marine animals, can only be effected extremely slowly, and undoubtedly takes place from competition with the shore fauna. We may suppose that the livelier struggle for existence which must arise in the littoral region or its vicinity, where an infinite number of various forms fight for subsistence, compels such forms, as lack sufficient power of resistance, to this so-called migration, and to retire to somewhat deeper and more peaceful regions, partly in their fully-developed state, partly in their later and more "conscious" embryonic stages, when, being independent of current and wind, they begin to crawl about. The others, from being unable to seek these places of refuge, succumb in that "Bellum omnium inter omnes" which is going on especially at or near the shore. But in proportion as the remaining shore fauna increases and extends downwards, even these formerly peaceful places become the field of a livelier competition in every respect, thereby necessitating a continual migration towards the greater depths.

The faculty hereby gained by the animals of enduring an ever-increasing depth, and of accommodating themselves to its conditions, being transmitted by inheritance and accumulated from generation to generation, must become a matter of great importance. If we take, for instance, two such forms as are with certainty known to belong to the same species, the one living at a great depth, let us say 1000 to 2000 fathoms, the other, on the contrary, belonging to shallow water, *e.g.*, *Brissopsis*, it appears to me impossible that the larvæ of the form accustomed to live near the shore should be able to attain their full development and to settle in the great depth; nor is the contrary case any more imaginable. The faculty of thriving and existing under such extremely peculiar conditions as are offered by the deep sea cannot be acquired at once. Indeed, we see every day examples of animals obliged to change climate and to alter their mode of life; the parents sustain the new conditions only with difficulty, or even perish by their influence, but their immediate progeny possesses greater power of resistance, and their later descendants do so to yet a higher degree, until the animal becomes finally acclimatised. The larva of a marine invertebrate or the full-grown animal itself, accustomed to live at a pretty moderate depth, for instance 50 to 100 fathoms, can only with difficulty, and during a short time, endure to live in an aquarium, however con-

veniently this may be fitted out; the differences in temperature, pressure, saltness, &c., are too great and the change too abrupt. Thus I think that a slow continuous emigration seawards is going on in the manner above sketched out, and there seems to be scarcely any doubt that the present deep-sea fauna will be changed in character in the course of time, chiefly on account of an emigration from the shore.

It is rather peculiar that such an emigration is not always necessarily accompanied with any very obvious alterations of the organisation of the animals. Striking examples of this fact are afforded, for instance, by those *Cucumariæ* which are met with in the depths. Nevertheless it must be admitted that, as a rule, judging at least from the Holothurioidea, alterations of a more or less essential nature are produced during the migration. But, on the other hand, there are strong grounds for supposing that most forms which have once surmounted the difficulties of the migration, and reached a more considerable depth, are in several respects endowed with the faculty of preserving "certain" of the characteristics of their ancestors, *i.e.*, the original shallow-water forms, longer than those descendants of the same ancestors which, from being able to maintain the struggle for existence with greater advantage, have remained in the littoral region. Indeed, natural selection ought to have played a far more important rôle in the latter region than in the monotony of the abysses, and to have in general called forth swifter and more perceptible changes. It is within the shore region that the Synaptidæ occur, which are of all Holothurids the most thoroughly modified and least Echinoderm-like in shape. Even the Molpadidæ, which are, in my opinion, somewhat older than the Synaptidæ, are extremely altered forms, although, like certain *Cucumariæ*, they have emigrated at a later period, and seem now to thrive principally at considerable depths.

Supposing that there is some truth in the hypothesis, which I shall attempt to prove below, that the common progenitors of all the Holothurioidea were not apodous *Synapta*-shaped animals, as has been hitherto asserted, but of the form of *Cucumariæ*, and provided with an open stone-canal, feet along the ambulacra, and a well-developed water-vascular system somewhat like that of the Echinids, it might appear strange that even among the present shallow-water forms there are to be found species which have in some respects maintained themselves almost like the primitive form. On the other hand, it ought not to be forgotten that, notwithstanding this similarity, these very forms have undergone great and sweeping changes. They have lost the communication of the stone-canal with the exterior, the calcareous ring is highly altered, the tentacles, which must originally have been simple and foot-like, have been transformed into very complicated dendroid organs, &c. And if we review the whole family of Dendrochirotæ more closely, they are found to have varied in every possible direction so as to adapt themselves to the various modes of life that necessarily follow from the infinitely varying conditions of the littoral region. The Dendrochirotæ have been split up, so to

speak, into a great number of types, diverging in widely different directions; compare the genera *Psolus, Colochirus, Cucumaria, Thyonidium*, &c.

But even the Elasipoda, which, from their number and often monstrous shapes, form such a characteristic feature of animal life in the bottom of the ocean, have suffered great alterations from the primitive type. Nevertheless they have still preserved much more of their important characteristics than any other Holothurid, and, if compared with one another, betray an evident tendency to uniformity in development, resulting no doubt from the monotony of the depths. It is probable that the Elasipoda have gained these modifications in the course of their migration towards deep water, and that a comparative repose has ensued in their evolution, after their having become acclimatised to the depths. However, life at the bottom of the ocean does not by any means permit of a stationary condition. The very fact of the Elasipoda occurring there in enormous masses clearly proves that fighting and development have gone on and are going on hand in hand there.

In the preceding remarks I have several times stated the opinion that the common ancestors of the Holothurioidea must have been *Cucumaria*-shaped animals furnished with an open stone-canal, feet, and a well-developed ambulacral system. This hypothesis, which can only be supported with a greater or less degree of probability, is contrary to the pedigrees proposed by my predecessors, in which the apodous Synaptidæ have been regarded as the oldest and least changed forms. Semper says, in his excellent work on the Holothurioidea of the Philippines :—"The apodous Holothurids are phylogenetically older than the pedate; the primitive form of the Holothurids cannot have been a pedate animal." In his opinion, these conclusions are justified by the fact that the water-vascular ring is the earliest persistent organ of the Holothurids, from which the other parts of the water-vascular system are afterwards developed. It seems to me that Semper has overlooked, as so many other inventors of pedigrees have done, the possibility of a reduction of organs taking place. However, the reduction and disappearance of organs is a fact that is quite as well established as the development of new ones; and in this particular case it appears much more probable that a reduction has taken place.

Without entering too far into details, I shall briefly state the reasons why I think it more probable that the pedate Holothurids are more primitive than the apodous. The Echinids, Asterids, and Holothurids have branched off from the same primitive type; on that point there is no doubt among the different authors. It is further well known that on examining the organisation of these classes somewhat more closely, we find—(1) that the water-vascular system, which is of extraordinary importance to and the most prominent characteristic of the Echinoderms, is entirely built on the same plan, inasmuch as it consists of a vascular ring, one or more stone-canals and Polian vesicles, and (excepting in the Apoda among the Holothurioidea) five radial ambulacral vessels giving out branches that pass internally into the ampullæ, externally into the feet, the latter

ending typically in a suctorial disk; (2) that the nervous system, which is scarcely less characteristic of the Echinoderms, is devoid of ganglia, and consists of a ring round the mouth with stems issuing from the ring and entirely following the water-vascular system. On account of these important coincidences, it appears to me that the common progenitor of the three classes ought to have had the above-mentioned organs already developed.

For it should not be assumed, I think, except from particularly cogent reasons, that these organs could have been developed so as to agree in every detail, after the three classes have diverged from one another. Accordingly, although in the apodous Holothurids the five radial ambulacral vessels are either totally wanting (in the Synaptidæ and some Molpadidæ), or, if existing, are without any connection whatever with the feet (in the rest of the Molpadidæ), it seems to me much more probable that this organisation of the Apoda is to be regarded as the result of a reduction than as an original condition. If a *Synapta*-shaped animal should be regarded as the common progenitor, the present apodous Holothurids must of course be considered to be its least altered descendants. Then we have to choose between two possibilities. There may have issued from this main stem a form that by developing ambulacral canals with feet and ampullæ has become the progenitor of the pedate Holothurids, the Echinids and the Asterids. In this case we arrive at the conclusion that the pedate Holothurids are more nearly related to the Echinids and Asterids than to the Apoda. The other possibility is that the pedate Holothurids on the one hand, and the Echinids and Asterids on the other, have branched off from the common main axis of the Echinoderms, and, independently of each other, developed feet and radial ambulacral vessels similar in detail. Although in this latter case the relationship between the Pedata and Apoda becomes more evident, still there remains the above-mentioned difficulty of understanding how such a complicated water-vascular system so similar in detail could have arisen, notwithstanding that the classes had developed independently of each other. On this account I think it more probable that the primitive form of the Holothurioidea has been a pedate animal, that the Synaptidæ represent their most differentiated form, and that in the Molpadidæ the reduction of the water-vascular system is still going on.

If, on the other hand, the derivation of the Holothurioidea is to be founded on Ontogeny, it would follow that the Elasipoda might justly claim to be regarded as being phylogenetically the oldest, because they have for the most part maintained the connection of the stone-canal with the exterior, and present such numerous instances of an extremely peculiar calcareous ring composed of spicules, and strongly reminding one of that of the larvæ, and because they have, moreover, in general, very primitive deposits in the perisoma, and have thus preserved many important peculiarities no doubt belonging to the common ancestors, but lost by the other Holothurioidea. The Elasipoda have, indeed, become much changed in other respects from the primitive type, as is

shown in my former work, but still it is clear, from the peculiar direction in which they have in general developed, that they cannot, since a very remote period, have had any connection with the other Holothurids, at least not with the Apoda, Rhopalodinidæ, and Dendrochirotæ. It is possible that the case is different with regard to the Aspidochirotæ. In this family the genus *Stichopus*, but above all the new genus *Pælopatides*, brought home by the Challenger Expedition, presents in its whole organisation such a bewildering resemblance to some Elasipoda belonging to the family Psychropotidæ, that it is almost impossible to find any other difference than the presence or absence of respiratory trees. Thus it does not seem improbable, though it cannot by any means be taken for granted, that the Aspidochirotæ and the Elasipoda have sprung from a common branch, and have afterwards diverged from each other, the former losing the connection of the stone-canal with the exterior, &c., the latter losing the water-lungs, which must then be supposed to have existed in their common progenitor.

Bathymetrical Distribution.

With regard to the bathymetrical distribution of Apoda and Pedata, our present knowledge does not enable us to speak of any results of very general value. However, the Challenger Expedition has been successful even in these respects, several important discoveries having been made, proving that the present shallow-water fauna has far more outposts in the great depths of the ocean than at first supposed. Before the Challenger Expedition set out, only a very few forms belonging to the Apoda and Pedata were known from depths exceeding 100 fathoms, and scarcely one below 200 fathoms. The following list presents a view of the species met with in the deep sea at depths from 500 fathoms and under (see p. 8).

This list induces me to believe the following remarks to be true, or, at least, to have some probability.

1. Descendants of the recent shallow-water Holothurioidea have escaped to the greatest depths at which any living Holothurid has been obtained, viz., 2900 fathoms, but they are by no means so prevalent as the Elasipoda, nor do they form such a characteristic feature in the abyssal fauna.

2. Most of the forms met with in the deep sea below 500 fathoms are distinct from the shallow-water species, though they belong to the same genera.

3. Several species have a vast bathymetrical distribution, some individuals of them still living near the shore, others having descended without any obvious change in their organisation into the considerable depth of 500 to 700 fathoms, or, exceptionally, even deeper.

4. A wider distribution seawards of a species seems to take place preferably in the northern and southern oceans, where the different belts proceeding from the vicinity of

land outwards would seem to have in general a greater uniformity in temperature and other physical conditions than in the tropical and subtropical regions, where it is stated that the belts below 100 or 200 fathoms have lost the influence of the climate, &c., and present conditions far different from those above them. Such forms are *Myriotrochus rinkii*, from shore to 500 fathoms; *Echinocucumis typica*, from about 40 to 530 fathoms; *Thyone raphanus*, from 20 to 530 fathoms; *Holothuria intestinalis*, from 10 to 650 fathoms; *Holothuria tremula*, from 20 to 672 fathoms; *Trochostoma violacea*, from 20 to 700 fathoms; *Thyonidium pellucidum*, from about 30 to 1081 fathoms, &c. The two deep-sea species of *Synapta* are scarcely distinguishable from some of the shallow-water species.

5. *Pælopatides*, *Pseudostichopus*, *Acanthotrochus*, and probably even *Ankyroderma* are the only true deep-sea genera of Apoda and Pedata, no representatives of them having hitherto been obtained near the shore or, at least, from any trifling depth. Species of these genera very seldom seem to thrive at a less depth than 500 fathoms.

6. Among the Apoda the Synaptidæ are, with a very few exceptions, shore forms, living near the surface of the sea, while the Molpadidæ are probably in a state of emigration seawards, a great number of them having already reached the abysses and settled there.

7. The Dendrochirotæ and Aspidochirotæ are still true shore or shallow-water forms, though there are even here many exceptions, proving that their representatives are thriving even at great depths.

Concerning the geographical distribution, I refer the reader to the Geographical Tables, accompanied by some general remarks, at the end of this Report.

TABLE SHOWING THE BATHYMETRICAL DISTRIBUTION OF THE HOLOTHURIOIDEA.

	Locality.	Depth in fathoms.
Myriotrochus rinkii, Steenstrup.	Skager Rack south of Arendal, North Atlantic Ocean and Arctic Sea.	shore to 500
Echinocucumis typica, Sars.	North Atlantic Ocean.	40 to 530
Thyone raphanus, Düb. and Kor.	North Atlantic Ocean and Mediterranean Sea.	20 to 530
Stichopus challengeri, n. sp.	Antarctic Ocean.	550
Pœlopatides appendiculatus, n. sp.	Off Japan.	560
Stichopus tizardi, Théel.	Færöe Channel.	530 to 570
Trochostoma thomsonii, Dan. and Kor.	North Atlantic Ocean and Arctic Sea.	136 to 658
Trochostoma (?).	South Atlantic Ocean.	40 to 600
Psolus murrayi, n. sp.	South Atlantic Ocean.	600
Psolus operculatus, Pourtalès.	North and South Atlantic Oceans.	120 to 600
Psolus antarcticus, Philippi.	Antarctic Ocean and South Atlantic Ocean.	20 to 600
Holothuria intestinalis, Ascan and Rathke.	North Atlantic Ocean.	10 to 650
Holothuria tremula, Gunner.	North Atlantic Ocean.	20 to 672
Ankyroderma marenzelleri, n. sp.	Off New Zealand.	700
Trochostoma albicans, var. *glabra*, n. sp.	Off New Zealand.	700
Pœlopatides aspera, n. sp.	Off Philippine Islands.	700
Trochostoma violacea, Studer.	Kerguelen and off New Zealand.	20 to 700
Holothuria lactea, n. sp.	Atlantic Ocean and off New Zealand.	700 to 1000
Thyonidium pellucidum, Flemming.	North Atlantic Ocean.	30 to 1081
Holothuria murrayi (var.?).	North Atlantic Ocean.	1090
Acanthotrochus mirabilis, Dan. and Kor.	Between Norway and Spitzbergen.	658 to 1110
Trochostoma albicans, n. sp.	South-east of New York.	1240
Stichopus torvus, n. sp.	South Pacific Ocean.	1375
Holothuria murrayi, n. sp.	South Pacific Ocean.	1375
Cucumaria abyssorum, var. *hyalina*, n. sp.	Antarctic Ocean and South Pacific Ocean.	1375 to 1600
Cucumaria abyssorum, n. sp.	Antarctic Ocean.	1600 to 1975
Pseudostichopus villosus, var. *violaceus*, n. sp.	Antarctic Ocean.	1975
Trochostoma, sp.?	West of Valparaiso.	2160
Pœlopatides confundens, n. sp.	South Pacific Ocean.	1375 to 2225
Cucumaria abyssorum, var. *grandis*, n. sp.	South Pacific Ocean.	1500 to 2225
Synapta abyssorum, n. sp.	Atlantic Ocean.	2350
Pseudostichopus villosus, n. sp.	Antarctic Ocean, Atlantic Ocean, and Pacific Ocean.	1375 to 2900
Holothuria thomsoni, n. sp.	North Pacific Ocean.	1875 to 2900

DESCRIPTION OF SPECIES.

Order I. APODA.

Body cylindrical or fusiform, devoid of pedicles and processes. Tentacles pinnate or digitate or peltate—digitate or simple unbranched.

Suborder I. APNEUMONA.

Respiratory-trees absent. Ciliated cups, attached to the mesentery, present. No radial ambulacral vessels.

Family SYNAPTIDÆ.

Genus *Synapta*, Eschscholtz, 1829.

Synapta beselii, Jæger, 1833 (Pl. I. fig. 12).

Habitat.—Zebu Reefs; several individuals. Amboina; several specimens. Reefs at Papiete; numerous individuals. Station 177, August 18, 1874; lat. 16° 45′ S., long. 168° 7′ E.; depths, 130 fathoms; a few specimens.

All the specimens dredged at the different localities above mentioned seem to agree most certainly with those described by Jæger, Müller, Semper, &c. However, no one has, so far as I know, noted anything with regard to the peculiarity, that the very numerous Polian vesicles are, as it were, branched, that is, that four or five of them arise from the same base, and that some of these always appear to be more or less rudimentary. This arrangement of the Polian vesicles is very conspicuous in the individuals from Zebu Reefs. Amongst the specimens brought home from the reefs at Papiete there are several provided with two branched madreporic canals, of which, as is well known, the typical forms have but a single one.

Synapta glabra, Semper, 1868 (Pl. I. fig. 6).

Habitat.—Zebu Reefs; several mostly rather incomplete specimens.

I hesitated long whether to refer the animals in question to *Synapta glabra*, Semper, or to *Synapta grisea*, Semper, or *Synapta serpentina*, Müller, forms which are very nearly related to it. According to Semper, however, the fact that the branches of the tentacles are webbed together by a thin membrane characterises *Synapta glabra* and distinguishes it from the remaining forms. Some of the specimens brought home from Zebu Reefs also seem to be in possession of such a web between the branches or digits, which are rather short, while in other forms this web is almost inconspicuous. Mostly, the branches of the tentacles are highly contracted, whence it is difficult to discern their arrangement, a difficulty greater inasmuch as the animals themselves have undergone some changes by reason of their long immersion in spirits. The calcareous ring is more nearly allied to that of *Synapta glabra* than to those of the other species. The stock or handle of the anchor (Pl. I. fig. 6, *a*) is provided with six to eight small processes which are rough with minute spines, and that part of the anchor where the arms or flukes join each other carries as many as eight or more small teeth.

Colour in alcohol, dark brownish on the upper surface and lighter on the under. Length of the largest specimen about 500 mm.

Another individual, also obtained at the same Station, possibly forms another species, but unfortunately the calcareous matters have been dissolved by the impure alcohol, and the crown of tentacles is destroyed, so as to make closer investigations impossible.

Synapta lappa, Müller, 1850 (Pl. I. fig. 7).

Habitat.—Gomera, off Tenerife, February 10, 1873; depth, 70 fathoms; several fragments.

The highly macerated and fragmentary condition of the individuals I have had at my disposal prevents minute examination. To judge from what I have observed, they must belong to this species of Müller. The Polian vesicles, the single madreporic canal, the shape of the calcareous ring and of the deposits in the body-wall, &c., agree most strikingly with the description of Müller. The tentacles, however, fifteen in one individual and sixteen in another, do not seem to be of quite equal size. Besides, the anchors have, as a rule, anteriorly where the flukes join each other, as many as eight small teeth. The numerous miliary granules resemble those in *Synapta grisea*, Semper, and *Synapta glabra*, Semper.

Synapta picta, n. sp. (Pl. I. figs. 9, 10).

Tentacles twelve, each with about twenty-five digits; one ventral tentacle considerably smaller than the others. Calcareous deposits closely resembling those in

Synapta recta, Semper, and *Synapta indivisa*, Semper. Length of the anchors about 0·24 mm., and that of the plates about 0·17 mm. Vertex of the anchors (Pl. I. fig. 9, *a*) with a few small teeth. Polian vesicles of varying size; five larger, the largest about 6 mm. long, and some rudimentary ones. Madreporic canal single. Immediately behind and attached to the calcareous ring (Pl. I. fig. 10) a narrow firm ring of connective tissue, which, however, does not occupy the whole space between the former and the water-vascular ring, but leaves the greatest part of the tentacular canals free. Colour in alcohol, reddish-brown, with numerous white spots, which are derived from agglomerations of miliary granules. Length of the individual, 30 to 35 mm.

Habitat.—Bermuda; a single specimen.

Synapta distincta, von Marenzeller, 1881 (Pl. I. fig. 8).

Habitat.—Japan, 8 to 50 fathoms; some fragments. Station 233B, May 26, 1875; lat. 34° 18′ N., long. 133° 35′ E.; depth, 15 fathoms; blue mud; some fragments.

To judge from the calcareous deposits, the fragments in question must belong to an animal, identical with, or at least very nearly related to, the species of v. Marenzeller. Most of the anchors have a length of 0·23 mm., but there are some scattered ones to be seen, which measure about 0·4 mm. The anchor-arms are commonly provided with five to six serrations, but I have also observed flukes with only two or three. The plates differ (Pl. I. fig. 8, *a*) from those in the typical form figured by v. Marenzeller in possessing more holes; they vary in length from 0·18 mm. to 0·3 mm. In addition to the ×-shaped miliary granules, which sometimes become more or less deformed, so as to present the appearance of minute spinous bodies with one, two, or more holes, numerous rounded or oval granules are present, resembling those found in the muscular coats of the body-wall of *Synapta digitata*, &c. Even in *Synapta distincta* these granules belong to the muscular layers or to that part of the integument which borders on them; as a rule, they seem to be present in all the species of this group of *Synaptæ* examined by me. The body-wall is yellowish-white, more or less transparent. Length of the largest fragment, 95 to 100 mm.

One of the fragmentary specimens brought home from Station 233B has the plates almost without spines or processes, while the other has them furnished with minute elevations; the former is peculiar in having the ×-shaped miliary granules very numerous and closely crowded. The anterior portion of another individual, which differs to some extent from the typical forms, was also obtained from Japan, whence I hesitated long whether to refer it to the species in question or to form a new one for it. The species of v. Marenzeller seems generally to be in possession of calcareous plates of a more irregular shape, and furnished with larger though fewer holes and smaller spines, than is the case in this individual. Besides, the miliary granules of this latter specimen seem to

be slightly larger and more numerous, and they partly resemble those figured by v. Marenzeller, but mostly have a more complicated form (Pl. I. fig. 8, *b*). At first sight it may appear as if the difference presented by the miliary granules were of such importance as to justify a new species, but at the same time I have seen a great number of transitional forms, which evidently prove that the simple ×-shaped granules can pass over into the more complicated ones.

The individual in question has twelve tentacles, each with four slender digitations. The integument is of a whitish colour, inclining to yellowish, and is covered with numerous minute papillæ. The madreporic canal is single and dorsal as to its position. No cartilaginous ring behind the calcareous ring. Five ventral Polian vesicles about 15 mm. long are present. The form of the calcareous ring is best seen by reference to the plates.

There is no doubt that *Synapta distincta*, v. Marenzeller, is very nearly related to several previously known species, viz., *Synapta pseudo-digitata*, Semper, *Synapta innominata*, Ludwig, *Synapta molesta*, Semper, and *Synapta benedeni*, Ludwig. All the forms here enumerated seem to be very closely allied to one another. When comparing their calcareous deposits, &c., one cannot but think that their distinguishing characteristics are mostly very unimportant. Moreover, our present knowledge is too unsatisfactory to decide to what degree the deposits of the same species are capable of varying in form as well as in size.

Synapta verrilli, n. sp. (Pl. I. fig. 1).

Tentacles twelve, each with four slender digitations. Two larger ventral Polian vesicles, about 5 mm. long, and between these two smaller ones. Madreporic canal single. No cartilaginous ring. The calcareous ring (Pl. I. fig. 1, *c*) almost like that in *Synapta similis*, Semper, or *Synapta molesta*, Semper. The anchors (Pl. I. fig. 1, *a*) often more or less distinctly asymmetrical, and their flukes commonly provided with about five serrations; the posterior margin of the handle rough from minute serrations. Length of the anchors about 0·3 mm. The irregularly rounded plates (Pl. I. fig. 1, *b*) with the margin rather uneven and never completed; their holes are large, comparatively few in number, and provided with minute spines round the margin. The holes are smaller and more numerous in the articular end of the plates. Length of the plates about 0·27 mm., and their greatest breadth about 0·25 mm. The miliary granules (Pl. I. fig. 1, *d*) only in the form of oval or oblong bodies. Colour in alcohol, yellowish-white. Length of the largest individual about 23 mm.

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; coral mud; two specimens.

This species seems to bear the greatest resemblance to *Synapta innominata*, Ludwig,

from which it is distinguished only by the lack of any × -shaped miliary granules, and by the anchors which are of equal size.

Synapta insolens, n. sp. (Pl. I. fig. 3).

Tentacles twelve, each with four digitations. Polian vesicles five, two of which are comparatively small. Madreporic canal single. Cartilaginous ring absent. The anchors (Pl. I. fig. 3, *a*) about 0·64 mm. long, asymmetrical or of almost symmetrical form, with twelve to eighteen serrations on each fluke. The posterior margin of the handle rough, with minute serrations. The plates (Pl. I. fig. 3, *b*), about 0·56 mm. long, and of about the same breadth, are pierced by numerous circular holes, which diminish in size from the centre to the circumference; numerous small spines are visible round the margin of the holes. The margin of the anterior half of the plates is free from any roughness, and evenly rounded, almost semicircular, while the margin of the remaining narrower part of the plates is, so far as I know, never completed. Miliary granules (Pl. I. fig. 3, *c*) are present only as rounded or oval bodies. The surface of the transparent body-wall is rough from the anchors. Colour in alcohol, yellowish-white. Length about 110 mm.

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; green mud; a single individual.

Synapta insolens must be nearly related to *Synapta bankensis* of Ludwig, from which, however, it differs by the want of the small anchors and plates as well as by a considerably fewer number of holes in the plates, &c.

Synapta aculeata, n. sp. (Pl. I. fig. 2).

The integument is very rough from the comparatively large anchors. The anchors (Pl. I. fig. 2, *a*, *b*, *c*, *d*) vary greatly in shape; scarcely one exactly resembles another. Those with flukes at each end of the shank are very rare. The flukes always carry six to eight serrations. The handle bears on its posterior margin some spinous processes. Length of the anchors about 1·1 mm. The plates (Pl. I. fig. 2, *e*) are concave on their upper surface, so that the margin of their sides becomes directed upwards or rather outwards. The margin of the plates is never completed, but uneven with processes. The holes in the plates are comparatively small, and the anterior ones are commonly larger than those in the centre; their margin is smooth. Length of the plates about 0·74 mm. The miliary granules (Pl. I. fig. 2, *f*), of an oval form, seem exclusively to belong to the ambulacra, where they are disposed in double rows. Colour in alcohol, light brownish or dirty white. The surface of the integument with numerous small scattered papillæ of a dark reddish colour. Length of the fragment I have had at my disposal about 65 mm.

Habitat.—Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; depth, 345 fathoms; bottom temperature, 41·1; green mud; a middle part of an individual.

Synapta challengeri, n. sp. (Pl. I. fig. 4).

Tentacles twelve, each with four digitations, the two inferior of which are smaller. Two ventral Polian vesicles. Madreporic canal single, dorsal. Cartilaginous ring absent. The anchors (Pl. I. fig. 4, *a*) from 0·24 to 0·33 mm. long, with some minute serrations on the flukes. The plates (Pl. I. fig. 4, *b*), from 0·18 to 0·23 mm. long, are oblong, comparatively small, very irregular, and as it were undeveloped; their holes have the margin smooth. The miliary granules (Pl. I. fig. 4, *c*), of very variable shape, are commonly oblong, and evidently belong to the muscular layers or to that part of the integument which borders on them. Integument is yellowish-white, and covered with minute papillæ. Length of the very narrow individual about 80 mm.

Habitat.—Station 174, August 3, 1874; lat. 19° 6′ S., long. 178° 14′ 20″ E.; depth, 140 fathoms; coral mud; two specimens.

Synapta incerta, Ludwig, and *Synapta dubia*, Semper, are forms nearly related to the species in question, but they differ from it in the shape of their miliary granules as well as in their calcareous plates being provided with a handle.

Synapta incerta, Ludwig, 1875, var. *variabilis*, nov. (Pl. I. fig. 5).

Habitat.—Japan, 8 to 50 fathoms; some more or less fragmentary individuals.

The only differences of importance to note between the specimen examined by me and the typical form concern the plates and the miliary granules. The plates (Pl. I. fig. 5) in the specimen obtained at Japan are not quite so regularly constructed, and the miliary granules are absent or oval, and never obtain the characteristic bracket-like form figured by Ludwig. Length of the anchors, 0·13 to 0·18 mm. Length of the plates, 0·1 to 0·12 mm. The flukes of the anchors with two to four minute serrations, and sometimes smooth. The body is very narrow, cylindrical. Length of the fragment about 72 mm. Tentacles twelve, with four rather long digitations, and a short obtuse middle knob. A single Polian vesicle present. Colour whitish, transparent, inclining to violet. It seems most probable that *Synapta dubia*, *incerta*, and *variabilis* represent varieties of one and the same species.

Synapta abyssicola, n. sp. (?) (Pl. I. fig. 11).

The plates (Pl. I. fig. 11, *b*) are almost circular and concave on their upward directed surface; for the most part they closely resemble those in *Synapta distincta*, v.

Marenzeller, figured by me, but here and there plates are to be found which have the margin of the holes quite smooth. No miliary granules are visible. The anchors (Pl. I. fig. 11, *a*), generally broken off, have some serrations on the flukes, and their handle is provided with several processes. Length of the anchors about 0·54 mm. Length of the plates about 0·52 mm.

Habitat.—Station 346, April 6, 1876; lat. 2° 42′ S., long. 14° 41′ W.; depth, 2350 fathoms; bottom temperature, 34°·0; Globigerina ooze; a small fragment.

The discovery of this abyssal *Synapta* is of very great interest, proving that the representatives of this genus belong not to the shallow-water fauna only, and it is rather unexpected that no more striking differences exist between forms living under such various conditions. In fact, *Synapta abyssicola* bears the strongest resemblance to several shallow-water forms, and is distinguished by no marked peculiarity. The anchors have the form common to most of the Synaptidæ occurring in shallow water, and the plates have the characters of those of *Synapta distincta*, v. Marenzeller, as well as of *Synapta pseudo-digitata*, Semper.

Genus *Chirodota*, Eschscholtz, 1829.

Chirodota purpurea, Lesson, 1830 (Pl. II. fig. 1).

Tentacles twelve, of equal size, each with about ten digitations, increasing in length towards the end of the tentacles, so that the two terminal are much longer than the remaining ones. There are also tentacles with as many as thirteen digitations. The thin integument is covered with minute dark papillæ, and in some specimens the dorsal surface is provided with whitish tubercles containing wheels. Excepting series of minute, obtuse, unbranched rods (Pl. II. fig. 1, *b*) along the muscular bands, there are only very scattered aggregations of wheels present. Diameter of the wheels (Pl. II. fig. 1, *a*) from 0·14 mm. to 0·16 mm. Madreporic canal single. Polian vesicles of unequal size, and varying in number from eight to sixteen. Calcareous ring consisting of twelve pieces, the five radial pieces being perforated for the nerves. Colour in alcohol, darker or lighter purplish-red. Length about 65 mm. or more.

Habitat.—Station 316, February 3, 1876; lat. 51° 32′ S., long. 58° 6′ W. (Falkland Islands); depth, 4 to 5 fathoms; mud; numerous more or less macerated individuals.

It is remarkable that the forms dredged at the Falkland Islands are devoid of any sigmoid deposits, while those found by the Challenger Expedition in the Strait of Magellan and at Kerguelen Island have, as a rule, such deposits. Therefore it seems to me far more credible that *Holothuria purpurea* of Lesson, which was also obtained at Falkland Islands (Soledad), is identical with the above described forms rather than with

Studer's *Sigmodota purpurea*, which is found living in the Strait of Magellan and at Kerguelen Island.

Chirodota contorta, Ludwig, 1875 (Pl. II. fig. 2).

Habitat.—Marion Island, 50 to 75 fathoms; several individuals. Off Christmas Harbour, 120 fathoms; one individual. Balfour Bay, 20 to 60 fathoms; several specimens. Betsy Cove, 25 fathoms; one individual. Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom temperature, 47·8; sand; a few individuals. Station 314, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom temperature, 46·0; sand; numerous individuals.

The tentacles with ten to twelve digitations, the terminal of which are largest. The sigmoid deposits (Pl. II. fig. 2, *b*) exactly resemble those described by Studer in *Sigmodota purpurea*. They reach a length of about 0·28 mm., while the diameter of the wheels is only 0·12 mm. The specimens brought home from Station 314 differ from the others in having the aggregations of wheels much more crowded, while the aggregations of wheels (Pl. II. fig. 2, *a*), especially in the individuals obtained at Marion Island, are very scattered, so that they almost appear at first sight to be devoid of them. The specimens examined by me differ from Ludwig's type in their violet colour. It seems very peculiar that all the individuals dredged by the Challenger Expedition in several localities at the Kerguelen Islands, as well as in or in the neighbourhood of the Strait of Magellan, belong to Ludwig's *Chirodota contorta*. Not a single specimen of Studer's *Sigmodota purpurea* was obtained, therefore I cannot help thinking that the very scattered aggregations of wheels have escaped the attention of Studer, because of the sigmoid bodies being so conspicuous by their number as well as by their size.

Chirodota australiana, Stimpson, 1856.

Habitat.—Port William (New Zealand, Falkland Islands?); depth, 5 to 10 fathoms; two specimens.

The species is nearly related to *Chirodota contorta*, and differs from it mainly in possessing but ten tentacles, each with about eight digitations, and in having a single Polian vesicle. Length of the specimens, 35 mm. Colour in alcohol, light dirty brown. The wheels and sigmoid bodies seem to be present all over the body. Diameter of the wheels, 0·14 mm. Length of the sigmoid deposits about 0·14 mm. From the macerated state of the animals, the arrangement of the aggregations of wheels is not distinct. A single madreporic canal is present. The reproductive organs consist of two very long, slender, simple genital tubes. The Challenger specimens seem to agree in all respects with the species of Stimpson.

Chirodota japonica, v. Marenzeller, 1881 (Pl. II. fig. 3).

Habitat.—Port Jackson, 2 to 10 fathoms. Some highly incomplete specimens.

The cylindrical body is very elongated, up to 170 mm. long or more. The alimentary canal is distended by sand so as to fill up the whole peritoneal cavity. The ten tentacles are provided with fourteen to sixteen digitations of almost equal length. No traces of wheels seem to be present. The sigmoid deposits (Pl. II. fig. 3), resembling those in *Chirodota contorta*, Ludwig, have a length of about 0·14 mm., thus being slightly larger than those in the type of v. Marenzeller; they are collected in groups of three to nine. A single Polian vesicle is present. Colour in alcohol is whitish-grey or pale brownish-violet, and the integument is covered with numerous small dark red or violet papillæ.

The species strictly belongs to the genus *Sigmodota*, proposed by Studer for the reception of forms which are devoid of wheels and are characterised by the possession of sigmoid deposits within the integument. So far as is known, no other difference exists, distinguishing *Sigmodota* from *Chirodota*. Now it seems to me that the genus *Sigmodota* would be well founded if it could be proved that the sigmoid deposits were really characteristic of it. This seems, however, not to be the case. In fact, Ludwig's *Chirodota contorta*, besides wheels, possesses such deposits, formed exactly after the same plan as those in the genus *Sigmodota*; consequently, the species just mentioned combines the two extremes with each other, and v. Marenzeller is doubtless right when placing the genus of Studer under the list of synonyms.

Chirodota sp. ?

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; blue mud. Some fragmentary individuals, so incomplete as to make it impossible to determine their position. Only agglomerations of wheels seem to be present. Tentacles destroyed.

SURVEY OF THE GENERA AND SPECIES, HITHERTO KNOWN, REFERRED TO THE APNEUMONA.

Family I. SYNAPTIDÆ.

Tentacles digitate or pinnate. Body cylindrical. Deposits in the shape of anchors or wheels, seldom absent.

Genus 1. Rhabdomolgus, Keferstein, 1863.

Tentacles ten, elongate, undivided, slightly lobate on the sides. Deposits absent in the perisoma (?). Hermaphrodite (?).

Rhabdomolgus ruber, Keferstein, 1863.

Habitat.—St. Vaast (Keferstein).

This remarkable form is very doubtful, and needs to be re-examined.

Genus 2. Anapta, Semper, 1868.

Tentacles twelve, small, pinnate, each with eleven fine digits. Body covered with papillæ, devoid of other deposits than minute elongate or oval grains. Hermaphrodite.

Anapta gracilis, Semper, 1868.

Habitat.—Manila (Semper).

Genus 3. Synapta, Eschscholtz, 1829.

Tentacles ten to twenty-five, digitate or pinnate. Deposits—anchors, anchor-plates, and miliary granules. Hermaphrodite.

A. Tentacles pinnate, mostly with numerous, always with more than five digits. Anchor-plates roundish or oval, always (excepting in *Synapta beselii*) symmetrically formed with six to seven large dentate holes, and, besides, some smaller smooth ones at their narrower articular end, which forms a distinct bow. Circumference of the plates mostly smooth and complete.

I. Tentacles twenty-five.

Synapta kefersteinii, Selenka, 1867; Semper, 1868.

Tentacles with thirty to eighty digits. A broad cartilaginous ring present. Numerous Polian vesicles. A single madreporic canal. Anchor-arms smooth. Anchor-plates with six larger dentate holes, and three larger and some small smooth ones at the handle. Miliary granules—small irregular rods or incomplete rosettes.

Habitat.—Sandwich Islands (Sel.) and Navigators' Islands (Semp.).

Among the Holothurians preserved in the State Zoological Museum in Stockholm I have found the anterior portion of a *Synapta* obtained from Navigators' Islands. It has twenty tentacles, two or three of which are slightly smaller, each furnished with as many as twenty-five digits on each side. The calcareous deposits, the numerous Polian vesicles, the cartilaginous ring, the single madreporic canal, &c., completely agree with those of *Synapta kefersteinii*. On account of the number of tentacles, I at first believed the animal in question to be a specimen of *Synapta tenuis*, but on closer examination it became apparent that it presented in many respects the most obvious resemblance to *Synapta kefersteinii*. So far as is known for the present, the number of tentacles is the only difference existing between the two species just mentioned, but, as a matter of fact, several species of *Synapta* are capable of variation in this very respect. There seems to be but little doubt that *Synapta kefersteinii* and *Synapta tenuis* are identical forms.

II. Tentacles twenty or twenty-one.

Synapta tenuis (*Fistularia*), Quoy and Gaimard, 1833; Selenka, 1867.

Tentacles with fourteen to sixteen digits. Unsatisfactorily known.

Habitat.—New Ireland (Quoy and Gaimard).

III. Tentacles fifteen.

1. *Anchor-plates asymmetrical, elongate, subrectangular, nearly twice as long as broad, with numerous holes with smooth margins. Madreporic canal branched.*

Synapta beselii, Jæger, 1833; J. Müller, 1850 and 1854; Held, 1857; Semper, 1868. *Oncinolabes fuscescens*, Brandt, 1835 (according to Ludwig 1881). *Synapta astrolabi*, Held, 1857. *Synapta agassizii*, Selenka, 1867.

Tentacles with numerous digits. Cartilaginous ring with fifteen holes posteriorly. Numerous Polian vesicles. Madreporic canal single, dorsal, branched. When living, the animal is characterised by five longitudinal double rows of numerous large, round protuberances. Anchor-arms smooth. Rosette-shaped miliary granules present.

Habitat.—Zanzibar (Selenka), Mauritius (Haacke, Ludwig), Indian Ocean (Ludwig), Celebes (Jæger), Society Islands (Selenka), Philippine Islands (Semper), Ualan in Caroline Islands (Brandt), Nicobar Islands (Semper).

(Mus. Holm.) Several specimens from Navigator Islands, Tahiti, Eimeo, Mauritius, and Goonong. One dredged at Tahiti seems to be Selenka's *Synapta agassizii*, distinct from the typical form by possessing five darker longitudinal bands.

2. *Anchor-plates symmetrical, with six to seven larger dentate holes. Madreporic canals simple.*

a. Cartilaginous ring present.

Synapta vittata (*Fistularia*), Forskaal, 1775; Jæger, 1833; Blainville, 1834; J. Müller, 1854; Held, 1857; Herapath, 1865; Ludwig, 1882. *Tiedemannia vittata*, Leuckart, 1830.

Body with a series of protuberances along the five broader whitish longitudinal bands (according to Forskaal). Cartilaginous ring present (according to Müller). Anchors with smooth arms, and anchor-plates with six larger dentate holes and three slightly smaller and some minute smooth holes (according to Ludwig). No fully satisfactory description is given.

Habitat.—Red Sea (Forskaal, Gray, Rüppel, &c.).

Synapta nigra, Semper, 1868.

Digits of the tentacles united by a web at their base. Numerous Polian vesicles. A single madreporic canal. Cartilaginous ring posteriorly with small holes. Anchor-arms smooth. Anchor-plates with six large dentate holes and three slightly smaller and some minute smooth holes. Miliary granules resembling incomplete rosettes.

Habitat.—Bohol (Semper).

b. Cartilaginous ring absent.

Madreporic canals numerous.

Synapta glabra, Semper, 1868; Ludwig, 1881. (?) *Oncinolabes mollis*, Brandt, 1835.

Digits of the tentacles united by a web as far as their middle. Body with round protuberances, like those in *Synapta beselii*. Numerous Polian vesicles. Anchor-arms smooth. Anchor-plates with seven large dentate holes and some small smooth ones at the handle; the seventh large hole is only partly dentate. Miliary granules—scattered rosettes.

Habitat.—Bohol (Semper), (?) Guahan in Marianne Islands (Brandt).

(Mus. Holm.) Two specimens from Fiji Islands, agreeing in all respects with those described by Semper. Colour uniformly reddish-brown or dark brown, which colour seems to characterise this species from the following three, which are marked with spots, bands, or shades of a darker colour on a lighter ground. So far as I can discover, the digits of the tentacles are united by a distinct web. Cartilaginous ring absent, but the tentacular canals are united by a web, excepting in the calcareous ring, where openings are left between them. Numerous small simple madreporic canals and Polian vesicles round the water-vascular ring.

Synapta grisea, Semper, 1868.

Digits of the tentacles free. Numerous Polian vesicles. Deposits like those in the preceding species, but the miliary granules are much more numerous and aggregated.

Habitat.—Bohol (Semper), Fitzroy Island and Queensland (Bell), Indian Ocean (Ludwig).

(Mus. Holm.) Two specimens dredged at Bowen, differing mainly from *Synapta glabra* in the colour, which, like that in *Synapta beselii*, is marked with spots, bands, and shades of a darker greenish-grey colour on a lighter dirty ground, and by possessing numerous rosette-shaped miliary granules collected in masses.

Synapta serpentina, J. Müller, 1850 and 1854; Semper, 1868. (?) *Synapta raynaldi*, Held, 1857. (?) *Synapta intestinalis*, Held, 1857.

This species seems to agree in all points with *Synapta grisea*, excepting with regard to the calcareous ring, which presents some small differences. They may probably be identical.

Habitat.—Celebes (Müller), Zanzibar (Selenka).

β. One or several madreporic canals.

Synapta lappa, J. Müller, 1850 and 1854.

Digits of the tentacles free. Numerous Polian vesicles. Anchor-arms smooth. Anchor-plates with seven large dentate holes, and two large and some minute smooth holes.

Habitat.—West Indies (Müller).

In 1850 Müller speaks of but a single madreporic canal, but in 1854 he says that one or several may be present. The miliary granules have probably been overlooked. The anchor-plates differ from those in the three preceding species in the presence of the two larger smooth holes at the handle.

γ. A single madreporic canal.

Synapta godeffroyi, Semper, 1868.

Tentacles fourteen to sixteen. Digits of the tentacles united by a web. Numerous Polian vesicles. Anchor-arms smooth. Anchor-plates with seven large dentate holes, and two large and several minute smooth holes at the handle; the seventh hole only partly dentate. Anchors often deformed. Miliary granules—rosettes.

Habitat.—Navigator Islands (Semper), Mauritius (Haacke, Ludwig).

(Mus. Holm.) One individual 310 mm. long obtained at the Pelew Islands. Tentacles fourteen, with the numerous small digits, as it seems, united by a thin web. Colour light yellowish or whitish-grey, with a darker line along each of the dorsal ambulacra, and with scattered rather large spots of a greenish-brown colour on the three dorsal interambulacra. Rosette-shaped granules numerous. Cartilaginous ring absent. Deposits and inner organisation fully agreeing with Semper's description.

Synapta polii, Ludwig, 1875.

Digits of the tentacles, about sixty, free. Numerous Polian vesicles. Anchor-arms smooth. Anchor-plates with six large dentate holes, and three large and some minute smooth holes. Miliary granules—rosettes.

Habitat.—Barbados (Ludwig).

This species must be very nearly allied, if not identical, to Müller's *Synapta lappa*.

The following species, probably belonging to the same group of Synaptæ, are unsatisfactorily known and need to be re-examined:—

Synapta bifaria, Semper, 1868. *Synapta* sp., Herapath, 1865.

Tentacles in two crowns, those in the exterior digitate or pinnate, those in the inner, on the contrary, simple unbranched.

Habitat.—Belfast in Ireland (Herapath).

Synapta radiosa (*Holothuria*), Reynaud, Lesson, 1830; Jæger, 1833; J. Müller, 1854. *Reynaudia* (?) *radiosa*, Brandt, 1835.

Very incompletely described. Probably identical with *Synapta beselii*.

Habitat.—Coromandel, at the Bay of Bengal (Lesson).

Synapta tentaculata (*Holothuria*), Forster, Blainville, 1821; Semper, 1868. *Pentacta tentaculata*, Jæger, 1833. *Cucumaria tentaculata*, Blainville, 1834. *Oncinolabes forsteri*, Brandt, 1835.

Very incomplete description. Probably nearly related to the group of *Synapta beselii*.

Habitat.—Rogit, Massachusetts (Blainville and Forster).

Synapta maculata (*Holothuria*), Chamisso and Eysenhardt, 1821; Jæger, 1833. *Fistularia maculata*, Blainville, 1834.

Very incomplete description. Related to *Synapta vittata, Synapta serpentina,* &c.
Habitat.—Radack (Cham. and Eysenh.).

Synapta mamillosa, Eschscholtz, 1829.

Very incomplete description. Possibly to be referred to *Synapta beselii.*
Habitat.—Society Islands (Eschsch.).

Synapta fasciata, Kuhl and van Hasselt, 1869; Ludwig, 1875.

Incomplete description. Related to *Synapta beselii.*
Habitat.—Java (Kuhl and Hasselt).

Synapta punctulata (*Fistularia*), Quoy and Gaimard, 1833; Brandt, 1835.

Very unsatisfactory description. Tentacles fifteen. Body papilliferous.
Habitat.—Port Dorey in New Guinea (Quoy and Gaimard).

Synapta doreyana (*Fistularia*), Quoy and Gaimard, 1833; Brandt, 1835.

Unsatisfactory description. Tentacles fifteen. Four series of rigid tubercles. Related to *Synapta beselii.*
Habitat.—Port Dorey in New Guinea (Quoy and Gaimard).

Synapta fusca (*Fistularia*), Quoy and Gaimard, 1833; Selenka, 1867. *Chirodota fusca*, Brandt, 1835.

Unsatisfactory description. Tentacles sixteen. Body smooth.
Habitat.—Carteret in New Ireland (Quoy and Gaimard).

Synapta reciprocans (*Fistularia*), Forskaal, 1775; Jæger, 1833. *Holothuria glutinosa*, Lamarck, 1816.

Habitat.—Suez (Forskaal), Red Sea (Gray).

Synapta rappardii, Held, 1857.

Habitat?

Synapta zebrina, Held, 1857.

Habitat?

IV. Tentacles thirteen.

Synapta indivisa, Semper, 1868.

Tentacles with about twenty very long, slender digits. Cartilaginous ring absent (?). Three Polian vesicles. A single madreporic canal. Anchor-arms smooth. Anchor-plates with six larger dentate holes, and three larger and some smaller smooth holes. Miliary granules rosette-shaped.

Habitat.—Samboangan, Mindanao (Semper).

Synapta recta, Semper, 1868.

Tentacles with very short digits. Cartilaginous ring present, with holes posteriorly. Nine long and three or four shorter Polian vesicles. A single madreporic canal. Deposits like those in the preceding species. Especially distinguished by the intestine not forming convolutions.

Habitat.—Bohol (Semper).

V. Tentacles twelve.

Synapta inhærens (*Holothuria*), O. F. Müller, 1788; Rathke, 1843; Düben and Koren, 1844 (*partim*); J. Müller, 1850. *Pentacta inhærens*, Jæger, 1833. *Cucumaria inhærens*, Blainville, 1834. *Dactylota inhærens*, Brandt, 1835. *Chirodota pinnata*, Grube, 1840. *Synapta duvernæa*, Quatrefages, 1842. *Synapta henslowana*, Gray, 1848. *Synapta girardii*, Pourtalès, 1851. *Synapta tenuis*, Ayres, 1854. *Synapta pellucida*, Stimpson and Kürtz, Ayres, 1854. *Synapta galliennii*, Herapath, 1865. *Synapta ayresii*, Selenka, 1867. *Leptosynapta tenuis*, Verrill, 1867–1871. *Synapta saruiensis*, Ray Lankester, 1868. *Leptosynapta inhærens*, Verrill, 1867–1871. *Leptosynapta girardii*, Verrill, 1874.

Tentacles with eleven to fifteen digits. Cartilaginous ring none. One to three Polian vesicles. A single madreporic canal. Anchor-arms dentate. Anchor-plates ovate, narrower towards the attachment to the anchor, but without any true narrow handle, with seven larger dentate holes and several larger and smaller smooth holes at the narrower end. Miliary granules present.

Habitat.—Scandinavian coasts from the Sound to Finmark (Düben and Koren, Danielsen, M. Sars, Rathke, Möbius, Ludwig, O. F. Müller, Danielsen and Koren). White Sea (Jarzynsky), British Islands (Woodward and Barret, Ray Lankester, Kinahan, Brady and Robertson, Thompson, M'Intosh, Norman, Herapath, Möbius and Bütschli, Herdman, Leslie and Herdman, &c.), North Atlantic Ocean between Scotland and Norway (Möbius and Bütschli), West coast of France (Quatrefages, Fischer, Barrois), Mediterranean Sea (J. Müller, Ludwig, &c.), New Jersey to Massachusetts Bay (Verrill, Pourtalès), Boston Harbour, Bird Island, Sag Harbour, South Carolina (Ayres). N. Carolina (Coues and Yarrow).

("Porcupine" Expedition). Three specimens from Station 35, July 26, 1869; depth, 96 fathoms.

(Mus. Holm.) Several specimens of Verrill's *Leptosynapta girardii* dredged at Newport. The miliary granules resemble minute curved or straight rods with one or both ends enlarged; sometimes they even have the shape of very incomplete rosettes.

Synapta gracilis, Selenka, 1867.

Tentacles with ten to twelve digits. Cartilaginous ring none. A single Polian vesicle and madreporic canal. In young individuals the anchors and plates are opaque and consist of arragonite crystals. In older forms the deposits always present a distinct roughness, but the arms of the anchors are transparent and dentate. The holes of the plates are minutely dentate. Tentacles without calcareous rods in the walls.

Habitat.—Massachusetts Bay (Selenka).

This species seems very doubtful. Selenka's figures give the impression of being drawn from deposits in a state of dissolution. Doubtless it is identical with the preceding species, to which the deposits bear a certain resemblance. Miliary granules unknown.

Synapta roseola (*Leptosynapta*), Verrill, 1874.

Habitat.—Long Island Sound and Vineyard Sound (Verrill), Provincetown and Cape Cod (Rathbun).

The species differs from *Synapta inhærens* mainly by the colour being rosy or pale red, due to minute red spots. Is doubtless not a distinct species.

Synapta albicans, Selenka, 1867.

Tentacles with about twenty-one digits. Cartilaginous ring absent. A single Polian vesicle and madreporic canal. Anchor-arms dentate. Anchor-plates with the usual number (seven) of large dentate holes and several almost smooth ones. Tentacles with numerous rods. Intestinal canal without circumvolutions (?).

Habitat.—Mendocino in California (Selenka).

Even this species seems not to be well defined. Miliary granules unknown.

Synapta ooplax, von Marenzeller, 1881.

Tentacles with nine, seldom eleven digits. Cartilaginous ring none. A single Polian vesicle and madreporic canal. Anchor-arms with two to three serrations. Anchor-plates ovate, with almost smooth margin, and with holes either smooth or dentate. Miliary granules present on the ambulacra—oval disciform with or without a central opening or slightly curved.

Habitat.—Japan or China (v. Marenzeller).

The following forms are more or less imperfectly known and need to be re-examined. They seem to belong to the same group as *Synapta inhærens*.

Synapta viridis (*Holothuria*), Lesueur, 1824; Lamarck, 1840. *Heterosynapta viridis*, Verrill, 1867–1871.

Tentacles unequal, eight larger with twelve to fourteen digits (pennatulæ), and four smaller destitute of digits. Body covered with small prehensile tubercles. Deposits unknown.

Habitat.—St. Thomas (Lesueur).

Synapta hydriformis (*Holothuria*), Lesueur, 1824; Lamarck, 1840. *Leptosynapta hydriformis*, Verrill, 1867–1871.

Tentacles twelve, equal, with twelve to fourteen digits, united at the base by a diaphanous membrane. Body furnished with very small, distant tubercles. Deposits unknown.

Habitat.—Guadaloupe (Lesueur).

Synapta verrucosa (*Chirodota*), Eschscholtz, 1829; Grube, 1850. *Leptosynapta verrucosa*, Verrill, 1867–1871.

Number of tentacles unknown. Each tentacle with nine digits; the terminal digit longer than the rest. Body covered with small reddish warts. Deposits unknown.

Habitat.—Sitcha (Eschscholtz).

Synapta lumbricoides (*Chirodota*), Eschscholtz, 1829; Grube, 1850.

Number of tentacles unknown. Each tentacle with eleven digits of almost equal size. Deposits unknown.

Habitat.—Radak (Eschscholtz).

Synapta pourtalesii, Selenka, 1867. *Synapta viridis*, Pourtalès, 1851. *Leptosynapta pourtalesii*, Verrill, 1867–1871.

Tentacles twelve, with about twenty digits. Deposits nearly of the same shape as those in *Synapta inhærens*.

Habitat.—Biscayne Bay in Florida (Pourtalès).

The species must be very nearly allied to *Synapta inhærens*.

Synapta dolabrifera, Stimpson, 1856.

Tentacles twelve, with about fourteen digits. Deposits crowded. Anchor-plates mostly with ten perforations, the middle largest. Anchors a little larger than the plates, with the extremity of the handle also provided with a double hook, though of very small size.

Habitat.—Port Jackson (Stimpson).

Synapta oceanica (*Holothuria*), Lesson, 1830; Jæger, 1833.

Tentacles ten, flat, pinnate or plumulose. Six membranous bands along the body; symmetrical, round protuberances occupy the intervals between these bands. Anchors present. Very unsatisfactory description.

Habitat.—Very common at Tahiti (Lesson).

There is no doubt that the above description is very incorrect. Lesson speaks wrongly of six longitudinal bands, and there is reason to believe that he also erred when stating the tentacles to be ten. Judging from the pinnate tentacles, from the presence of longitudinal series of round protuberances, from the length (3 feet) of the body, and, finally, from the locality itself, where the animal is found in abundance, I am much inclined to refer the species of Lesson to Jæger's *Synapta beselii*, which is known to be common at the Society Islands. Selenka and Semper referred Lesson's species to those with twelve tentacles.

VI. Tentacles ten.

Synapta reticulata, Semper, 1868.

Tentacles with ten to twelve thick, distant digits. Cartilaginous ring present, with large holes posteriorly. Polian vesicles eight to ten. Madreporic canal single. Anchor-arms smooth. Anchor-plates symmetrical, with seven larger dentate holes and some smaller smooth ones. Miliary granules rosette-shaped.

Habitat.—Bohol (Semper).

B. Tentacles digitate, with few, never more than five digits. Anchor-plates, almost without exception, asymmetrical, with numerous often smooth holes, which for the most part are irregularly arranged; very seldom a handle at the articular end, which is often more or less distinctly truncated, and has the bow indistinct or even absent. Circumference of the plates mostly uneven or incomplete.

I. Tentacles thirteen.

Synapta uncinata, Hutton, 1872.

Tentacles very short, merely tubercles, with two incurved hooks at the end of each. Anchor-flukes equal. Very unsatisfactory description.

Habitat.—New Zealand (Hutton).

II. Tentacles twelve, with four digits.

1. *Anchors very asymmetrical, one of the arms being smaller and bent toward the shank so as to form a more acute angle with it than does the longer arm.*

Synapta petersi, Semper, 1868.

The short anchor-arm with three to four serrations. The long anchor-arm smooth, forming an obtuse rounded angle with the shank. Anchor-handle with irregular processes. Anchor-plates with uneven margin, smooth holes, and without any marked handle. Miliary granules minute, ×-shaped. Inner organs unknown.

Habitat.—Amboina (Semper).

Synapta asymmetrica, Ludwig, 1875.

Anchor-arms smooth or serrated. The shorter arm forms a considerably sharper angle with the shank than the longer. Anchor-handle without processes, often curved. Anchor-plates with smooth or slightly dentate margin, with very numerous dentate holes, and without any marked handle. Miliary granules—small, regular plates, with four dentate holes. Four Polian vesicles. A single madreporic canal.

Habitat.—Banka at Sunda Islands (Ludwig).

(Mus. Holm.) One specimen obtained at Banka, agreeing in all respects with the description of Ludwig.

2. *Anchors almost symmetrical.*

a. Anchor-plates oval or elongate with a distinct narrow handle, almost complete margin and comparatively fewer holes.

Synapta dubia, Semper, 1868.

Anchor-arms smooth. Anchor-plates more elongate, irregularly perforated, with even margin and smooth unequal holes, and with some small holes in the narrow handle. Miliary granules ×-shaped. Inner organs unknown.

Habitat.—Bohol and Cebu (Semper).

Synapta incerta, Ludwig, 1875.

Anchor-arms serrated. Anchor-plates like those in the preceding species, but more symmetrically formed. Miliary granules—minute rods curved like brackets. Tentacles and inner organs unknown.

Habitat.—Banka at Sunda Islands (Ludwig).

Considering that the tentacles are unknown, this species may possibly be referred to the group with five digits in each tentacle.

b. Anchor-plates more or less irregularly rounded, without any marked handle, with uneven or incomplete margin and smooth rather numerous holes.

Synapta bidentata, Woodward and Barrett, 1858.

Anchor-arms smooth but bifid. Anchor-plates obovate, truncated at the articular end, and with numerous holes. Miliary granules rather large, very numerous, resembling cruciform fragments of anchor-plates. Inner organs unknown.

Habitat.—China (W. and B.).

Synapta molesta, Semper, 1868.

Anchors small, and as it were undeveloped. Anchor-arms smooth, not bifid. Anchor-plates very irregular, without bow. Miliary granules cruciform or resembling minute irregular plates pierced by a few holes. A single madreporic canal. Four long Polian vesicles.

Habitat.—Bohol (Semper).

III. Tentacles twelve, with five digits, the terminal one being more or less inconsiderable.

Synapta digitata (*Holothuria*), Montagu, 1815; Müller, 1850 and 1852; Baur, 1864; Woodward and Barrett, 1858. *Fistularia digitata*, Lamarck, 1816. *Holothuria inhærens*, Delle Chiaje, 1823. *Müllèria digitata*, Fleming, 1828. *Thyone digitata*, Blainville, 1834. *Chirodota chiaii*, Grube, 1840. *Chirodota digitata*, Forbes, 1841. *Synapta digitata*, var. *thompsoni*, Herapath, 1865; Barrois, 1882.

Anchors slightly unequal in size. Anchor-arms smooth or with some serrations. Anchor-plates slightly elongate, with a marked narrow handle, almost like that in Semper's *Synapta dubia*, irregularly perforated and with the holes smooth. Miliary granules numerous, oblong or hour-glass shaped, especially crowded over the muscular bands. Madreporic canal and Polian vesicle single.

Habitat.—British Islands (Montagu, Woodward and Barrett, Thompson, Kinahan, Forbes, &c.), France (Barrois, Fischer), Spain, at Vigo Bay (Woodward and Barrett), Mediterranean Sea (Ludwig, Sars, J. Müller, Grube, Heller, &c.).

Synapta benedeni, Ludwig, 1881 and 1882.

Anchor-arms with some small, obtuse serrations. Anchor-plates slightly elongate, truncated at the articular end, thus in want of handle, with uneven margin and the numerous holes sparingly dentate in their margin. Miliary granules numerous, small, rod-like. Six Polian vesicles and a single dorsal madreporic canal.

Habitat.—Brazil (Ludwig).

IV. Tentacles constantly eleven.

Synapta tenera, Norman, 1864 (no description); M'Intosh, 1875; Brady and Robertson, 1871. (*?*) *Synapta inhærens*, Düben and Koren, 1844 (*partim*). *Synapta buskii*, M'Intosh, 1865–1866.

Each of the eleven tentacles with three slender digits of almost equal length, or the terminal slightly larger; behind these digits two or three transverse ridges may be found, by means of which the tentacles get the appearance of having two or three pairs of short, obtuse processes behind the above-mentioned digits. These processes are not, however, true digits. Anchors with serrations on the arms. Anchor-plates rather characteristic, and differing from those of any other Holothurids; they are very symmetrical, rounded, hexagonal, with a long narrow handle, which has regularly two small smooth perforations; the plates themselves are pierced by seven dentate holes, of which that close to the handle is slightly smaller, transverse in position, and curvate. By means of those very symmetrically formed plates *Synapta tenera* approaches the group of Synaptæ with numerous digits on the tentacles. No miliary granules (?). Body is most translucent, and of a pale flesh colour. Polian vesicle and madreporic canal single. Length about 35 mm.

Habitat.—British Islands (Norman, Brady and Robertson, M'Intosh), Sognefjord in Norway (Danielssen and Koren).

(Mus. Holm.) A very great number of specimens from the west coast of Sweden, where it is one of the most common animals, on a bottom of muddy clay.

V. Tentacles ten, each with four digits and a small terminal tubercle.

Synapta similis, Semper, 1868.

Anchor-arms with serrations. Anchor-plates irregularly rounded with incomplete margin, and without handle but with numerous smooth holes. Miliary granules rod-like, cruciform. One to two Polian vesicles. A single madreporic canal.

Habitat.—Bohol (Semper).

VI. Tentacles and inner organs unknown, only fragments of animals having been examined.

1. *Anchors of two kinds, viz., large and small.*

a. Holes of the anchor-plates dentate.

Synapta bankensis, Ludwig, 1875.

Anchor-arms serrate. The smaller anchors and their plates are a fifth or a sixth of the larger. Anchor-plates roundish ovate, rather symmetrical, sparingly serrated in their almost even circumference, and with very numerous, small, dentate holes; no handle. Miliary granules minute, rounded or biscuit-shaped.

Habitat.—Banka (Ludwig).

(Mus. Holm.) One incomplete specimen dredged at Banka, agreeing nearly in all respects with the description of Ludwig. I only find that the small anchor-plates are more irregular, and provided with comparatively larger and fewer holes than the larger plates, and that often some of the central holes are considerably larger than the rest.

Synapta innominata, Ludwig, 1875.

The larger anchors, present only in the five ambulacra, are more than twice as long as the smaller. Arms of the smaller anchors with one or two serrations, those of the larger with numerous. Anchor-plates irregularly rounded, with incomplete margin and rather large, slightly dentate, about twenty-five or more holes; no handle. Miliary granules elongate cruciform.

Habitat.—Philippine Islands (Ludwig).

b. Holes of the anchor-plates smooth.

Synapta pseudo-digitata, Semper, 1868.

The larger anchors are more than thrice as long as the smaller. Arms of the larger anchors serrate, while those of the smaller seem to be smooth. Anchor-plates roundish oval, with uneven margin and numerous smooth holes; no handles. Miliary granules—small, elongate, cruciform bodies.

Habitat.—Bohol (Semper).

2. *Anchors of one kind.*

a. Anchor-plates with low ridges or prominences between the holes.

Synapta distincta, von Marenzeller, 1881.

Anchor-arms with minute serrations. Anchor-plates roundish oval, with incomplete margin and numerous smooth holes; no handle. Miliary granules cruciform, with the short arms spinous.

Habitat.—Miya in Japan (von Marenzeller), Amoy (Ludwig).

b. Anchor-plates smooth, without ridges.

Synapta autopista, von Marenzeller, 1881.

Anchors short and robust, with a few larger and smaller serrations at the ends of the arms. Anchor-plates asymmetrical, roundish angular, with uneven incomplete circumference and numerous smooth holes; no handle. Miliary granules, × -shaped or plate-like with a few holes and knobs.

Habitat.—Miya in Japan (von Marenzeller).

This species does not seem to be well defined. Von Marenzeller remarks that it bears in some respects a certain resemblance to Semper's *Synapta molesta*.

Synapta hispida, Heller, 1868.

Anchor-arms smooth. Anchor-plates oval with slightly uneven margin and numerous (about 28) smooth holes; no handle. Present some similarity to *Synapta digitata*

Habitat.—Lesina (Adriatic Sea), Heller.

The following species are quite unknown as regards internal and external organisation:—

Synapta inæqualis, Hutton, 1872.

Habitat.—New Zealand (Hutton).

One of the anchor-arms being much longer than the other, this species may possibly be nearly allied to Ludwig's *Synapta asymmetrica*.

Synapta bachei (?), Ayres, 1854.

Habitat?

(?) *Synapta vivipara* (*Synaptula*), Œrsted, 1851; Ludwig, 1881.

Habitat.—West Indies (Œrsted).

Nothing is known of this animal excepting that it is provided with anchors, and is viviparous. Agreeing with the views of Ludwig, I cannot consider a genus justified only on account of its representatives being viviparous. Therefore I think it most proper, for the present, to refer the species of Œrsted to *Synapta* or *Chirodota*, and to omit his genus *Synaptula*.

Genus 4. Chirodota, Eschscholtz, 1829.

Tentacles ten to twenty, peltate digitate. Deposits—groups of wheels, enclosed within warts in the integument, and, besides, often small more or less curved rods or **S**-shaped bodies. Wheels regularly with six spokes. Exceptionally **S**-shaped bodies alone present. Hermaphrodite.

A. No wheels, only S-shaped bodies.

Chirodota japonica, von Marenzeller, 1881.

Tentacles ten, with fourteen to sixteen digits. A single Polian vesicle. S-shaped bodies collected in heaps, four to seven in each, with their curled end directed towards the periphery of the heaps.

Habitat.—Eno-Sima, Japan (v. Marenzeller).

Chirodota studerii, Théel. *Sigmodota purpurea*, Studer, 1877. *Chirodota purpurea*, J. Bell, 1881.

Tentacles twelve, digitiform. S-shaped bodies rare.

Habitat.—Kerguelen Islands and Strait of Magellan (Studer), Elizabeth Island (Jeffrey Bell).

For reasons given above in the text, I think it most credible that the species of Studer is distinct from that of Lesson, therefore the specific name *purpurea* must be kept for Lesson's species. Compare even my remarks in the text under *Chirodota contorta*. The description of Studer is very brief.

Chirodota ferruginea (*Toxodora*), Verrill, 1882.

Tentacles twelve, with numerous digitations. Skin thin, somewhat translucent, filled with minute reddish-brown pigment-cells, and having numerous, minute, slender plates in the shape of a bow, or a parenthesis, with the ends incurved.

Habitat.—Southern coast of New England (Verrill).

On reading the summary description of Verrill, it is impossible to find any definite distinction between this species and the preceding one.

B. Wheels together with S-shaped bodies.

Chirodota contorta, Ludwig, 1875.

Tentacles twelve, with thirteen to fourteen digits. Six to seven Polian vesicles. The wheel papillæ irregularly scattered over the interambulacra, more numerous on the bivium and in the anterior part of the body.

Habitat?

Chirodota australiana, Stimpson, 1856.

Tentacles ten, each with ten serrulated digits. Body with two kinds of papillæ, the smaller, spread everywhere, consisting of accumulations of spicules which are hooked at one extremity and slightly bent at the other; the larger, white ones consist of accumulations of wheels and are scattered, quite thickly, along one side of the body only.

Habitat.—Port Jackson (Stimpson).

C. Wheels alone or in company with minute grains or half-moon-shaped bodies.

I. Tentacles ten.

Chirodota dunedinensis, Jeffrey Parker, 1881.

Each of the tentacles with about ten digits. Calcareous spicules in the form of wheels. Description not very satisfactory.

Habitat.—Otago Harbour, New Zealand (Parker).

II. Tentacles twelve.

1. *Digits of the tentacles numerous, about twenty.*

Chirodota violacea, Peters, Müller, 1849, 1850, 1854.

Wheel-papillæ arranged in five irregular series. Besides the wheels, numerous minute grains in the shape of half-moons. One or more Polian vesicles.

Habitat.—Mozambique (Müller).

2. *Digits of the tentacles few, rarely more than thirteen.*

Chirodota lævis (*Holothuria*), Fabricius, 1780; Grube, 1850; Lütken, 1857; Duncan and Sladen, 1881. *Holothuria pellucida*, Vahl, O. F. Müller, 1788–1806. *Pentacta pellucida*, Jæger, 1833. *Pentacta lævis*, Jæger, 1833. *Cucumaria pellucida*, Blainville, 1834. *Cucumaria lævis*, Blainville, 1834. *Dactylota pellucida*, Brandt, 1835. *Dactylota lævis*, Brandt, 1835. (?) *Thyonidium pellucidum*, Sars, 1851. (?) *Synapta coriacea*, Agassiz, 1852. (?) *Trochinus pallidus*, Ayres, 1854. (?) *Chirodota tigillum*, Selenka, 1867. (?) *Chirodota typica*, Selenka, 1867.

Each of the tentacles with ten to twelve digits. Wheel-papillæ twenty to thirty in each of the three dorsal interambulacra, three to twelve in the two ventral interambulacra, the two latter being always naked in their middle. Polian vesicles several (ten to fourteen or more). Neither Sars nor Duncan and Sladen seem to have found any other deposits in the integument than wheels.

Habitat.—North-west coast of Norway at Nordlanden and Lofoten (Vahl, Sars), White Sea (Jarzynsky), Spitzbergen (Ljungman), Greenland (Lütken, Duncan and Sladen,

Norman, Ludwig, Fabricius, Stimpson, &c.), north of American continent, viz., Fundy Bay (Stimpson), (?) Massachusetts Bay (Selenka), East Port (Selenka, Ayres, Verrill), Labrador and Grand Manan (Verrill).

(Mus. Holm.) Numerous specimens from different localities of the Arctic Sea.

Chirodota rotifera (*Synapta*), Pourtalès, 1851; Stimpson, 1860; Verrill, 1867–1871; Ludwig, 1881 and 1882.

Each of the tentacles with twelve, or fewer, digits. Wheel-papillæ scattered all over the interambulacra. Polian vesicles several. Besides the wheels, a few slightly curved rods with the ends slightly enlarged and uneven.

Habitat.—Biscayne Bay, Florida (Pourtalès), Brazil (Ludwig), Bahia and Abrolhos Reefs (Rathbun and Verrill).

According to Ludwig the colour is whitish, while the specimens examined by Pourtalès and Verrill were of a light purplish colour and have only eight to ten digits on each tentacle. The species in question differs from the preceding one mainly by its being viviparous (according to Ludwig), by the presence of curved ribs besides wheels, and by the arrangement of the ciliated cups. Notwithstanding this, the two species must be very nearly allied.

Chirodota rigida, Semper, 1868.

Tentacles with about thirteen digits. Crowded whitish wheel-papillæ on the dorsal interambulacra; simple rows of them along the ventral interambulacra. Besides the wheels, curved rods with the ends slightly spinous. Four large and ten to twelve small Polian vesicles.

Habitat.—Bohol, Philippine Islands (Semper).

Chirodota pygmæa, Müller, 1850.

Tentacles with eight digits. Wheel-papillæ arranged in five irregular series. Several Polian vesicles.

Habitat? According to Verrill it belongs to the Caribbean fauna, but Müller himself supposes it to have been dredged in the Mediterranean Sea. The species is imperfectly known, possibly identical with one of the preceding forms.

Chirodota eximia, Haacke, 1880.

Tentacles with seven digits. Wheel-papillæ arranged in five simple interradial rows. Besides the wheels, numerous buttons (= schnallenförmiger Hautkalkkörper).

Habitat.—Mauritius (Haacke).

Chirodota purpurea (*Holothuria, Fistularia*), Lesson, 1830; Jæger, 1833.

Habitat.—Soledad in Falkland Islands (Lesson).

Compare the description given in the text concerning the Challenger specimens. According to Lesson, only ten tentacles, each with six digits, are present, but

this may probably depend upon some error in the determination. In general, the descriptions of Lesson are very defective, but even he mentions the small tube-like tubercles on the dorsal surface, observed by myself in the Challenger specimens.

As a rule, the species of the genus *Chirodota* are very difficult to distinguish from each other. The one form passes imperceptibly into the other in such a manner that no special specific characteristics can be drawn up. The representatives of this genus are, as it were, in a state of evolution, only few species having been hitherto differentiated. However, our present knowledge is too unsatisfactory to decide on the validity of several so-called specific characters. The number of tentacles and digits as well as the colour, the arrangement of the wheel-papillæ, &c., seem to be subject to great variation. If this be so, it may follow, for instance, that *Chirodota purpurea* is the Antarctic form of the Arctic *Chirodota pellucida*, and that *Chirodota rotifera* of Pourtalès unites these two extremes.

III. Tentacles fifteen to twenty.

Chirodota discolor, Eschscholtz, 1829; Grube, 1850 and 1851; Ludwig, 1881. *Liosoma sitchaense*, Brandt, 1835 (according to Ludwig).

Tentacles twelve (seldom eleven or fifteen), each with twelve to fourteen digits. A row of white papillæ along three of the interambulacra.

Habitat.—Sitka (Brandt and Eschscholtz), Sea of Okotsk (Grube).

Chirodota incongrua, Semper, 1868.

Tentacles sixteen, each with eighteen to twenty digits. Wheel-papillæ in five not very crowded interambulacral rows. Six larger and two smaller Polian vesicles.

Habitat.—Camiguin in Philippine Islands (Semper).

Chirodota variabilis, Semper, 1868; Ludwig, 1881. *Chirodota refuscens*, Brandt, 1835 (according to Ludwig [1]).

Tentacles seventeen to eighteen, each with twenty-two to twenty-four digits. Wheel-papillæ equally distributed all over the body. Six to twelve Polian vesicles. Besides the wheels, slightly curved ribs or rods are present, with the serrate ends slightly enlarged.

Habitat.—Mariveles, Philippine Islands, and Cape York (Semper), Bonin Island (Brandt), Sunda Strait (Sluiter), Hong Kong (Ludwig), Japan, Timor, and Batavia (Ludwig).

The specimen obtained from Australia differs slightly with regard to its tentacles and deposits, whence Semper considers it as a variety.

(Mus. Holm.) One individual with seventeen tentacles, dredged at Singapore.

[1] According to Ludwig, *Aspidochir mertensii* of Brandt is either a *Synapta* or a *Chirodota*. It is captured at Sitcha.

Chirodota vitiensis, Gräffe, Semper, 1868.

Tentacles eighteen, each with twenty digits. Wheel-papillæ much more thinly scattered on the two ventral interambulacra. Six large and three small Polian vesicles. Especially characterised by the smallness of the calcareous ring.

Habitat.—Fiji Islands (Semper).

Chirodota dubia, Semper, 1868.

Tentacles eighteen, each with eighteen to twenty digits. Wheel-papillæ scattered all over the body. Five larger and three smaller Polian vesicles. Besides the wheels, small ribs or rods.

Habitat.—Camiguin in Philippine Islands (Semper), Ceylon (Walter).

So far as I can discover, this species is very closely allied to *Chirodota variabilis*, *Chirodota incongrua*, *Chirodota vitiensis* and possibly even to *Chirodota discolor*, and there seems to be good reason for the supposition that they are varieties of the same species.

Chirodota panaensis, Semper, 1868.

Tentacles nineteen, each with thirty to thirty-two digits. Wheel-papillæ scattered all over the body. Three larger and five to seven smaller Polian vesicles. Besides the wheels, small oval or elongate rods.

Habitat.—Philippine Islands (Semper).

Chirodota rubeola (*Fistularia*), Quoy and Gaimard, 1833; Selenka, 1867.

Tentacles twenty. Body smooth. Description very unsatisfactory.

Habitat.—New Ireland (Quoy and Gaimard).

Genus 5. Myriotrochus, Steenstrup, 1851.

Tentacles twelve, digitate. Deposits—large, free, scattered wheels with numerous (as many as nineteen) spokes and about as many rather large triangular teeth, directed inwards from the margin. Sexes distinct.

Myriotrochus rinkii, Steenstrup, 1852; Lütken, 1857; Théel, 1877; Danielssen and Koren, 1879 and 1882; Duncan and Sladen, 1881. (?) *Chirodota brevis*, Huxley, 1852. (?) *Oligotrochus vitreus*, M. Sars, 1866, and G. O. Sars, 1871. *Myriotrochus vitreus*, Duncan and Sladen, 1881.

Habitat.—Coast of Norway from Christiania Fjord to the Arctic Sea north of Norway (Sars, Storm, Danielssen and Koren), Nova Zembla and Sea of Kara (Théel, Stuxberg), Spitzbergen (Ljungman, Heuglin, Danielssen and Koren), Barents Sea (Hoffman), Greenland (Steenstrup, Lütken, Norman, Duncan and Sladen,

Möbius, &c.), north of American continent, viz., Assistance Bay (Huxley), Labrador (Verrill), Port Foulke (Stimpson), Discovery Bay (Duncan and Sladen).

(Mus. Holm.) A very great number of specimens from Skagerrak, south of Arendal, Spitzbergen, Greenland, Nova Zembla, Sea of Kara, and the northern coast of Asia. Danielssen and Koren and Duncan and Sladen are of opinion that the forms examined by Steenstrup and Lütken are distinct from those described by Sars and myself, and they base their supposition on the fact that the former have stalked wheels, but not the latter. However, I cannot quite agree with them, whence I think a careful re-examination and comparison necessary. Though I have had the opportunity of studying a very great number of specimens from different localities, I never found stalked wheels, except in specimens which were more or less macerated, whereby the wheels become free from the surrounding tissue and become attached by their centre to threads of connective tissue. However, it may possibly be that the animal possesses the capacity of protruding the wheels with their surrounding tissue beyond the level surface of the skin, but according to my opinion, this may be common to all forms. The specimens obtained at the southern localities are peculiar from the scantiness of wheels.

Genus 6. Acanthotrochus, Danielssen and Koren, 1879 and 1882.

Tentacles twelve, digitate. Deposits—free, scattered wheels of two kinds; the smaller with about twenty-two triangular teeth, directed inwards from the rim and generally furnished with eleven spokes; the larger with eight to eleven spokes and with as many long processes directed outward from the rim. Spokes of the wheels with wing-like margins.

Acanthotrochus mirabilis, Danielssen and Koren, 1879 and 1882.

Habitat.—Between Spitzbergen and Norway. Lat. 73° 47′ N., long. 14° 21′ E.; depth, 767 fathoms; Biloculina clay. Lat. 71° 59′ N., long. 11° 40′ E; depth, 1110 fathoms; Biloculina clay. Lat. 74° 54′ N., long. 14° 53′ E.; depth, 658 fathoms; brown and grey clay (Danielssen and Koren).

Genus 7. Trochoderma, Théel, 1877.

Tentacles ten, digitate. Deposits—crowded, free wheels in several superposed layers with the rim very spinous; the spokes more than six, varying from ten to sixteen.

Trochoderma elegans, Théel, 1877.

Habitat.—Nova Zembla and Sea of Kara (Théel, Stuxberg).

Suborder II. PNEUMONOPHORA.

Respiratory-trees present. Radial ambulacral vessels present or not.

Family, MOLPADIDÆ.

Genus *Ankyroderma*, Danielssen and Koren, 1879 and 1882.

Ankyroderma danielsseni, n. sp. (Pl. II. fig. 6).

Body fusiform, anteriorly truncated, posteriorly diminishing into a narrow caudal portion. Tentacles fifteen (?), retracted, very short, each with a pair of minute processes near the rounded end. Anal processes or teeth absent. Calcareous ring almost resembling that in *Trochostoma violaceum*. Polian vesicle single. Madreporic canal single, terminating within a tubercle, attached to the body-wall in the medio-dorsal line. Fifteen long slender tentacular vesicles. The longitudinal muscular bands double, and without retractors. Respiratory-trees two, the left considerably longer than the right one, and anteriorly reaching the gullet and calcareous ring and attached to them. The two fascicles of the reproductive organs very thin, and consisting of a few elongate slightly branched sacs. Integument thin and rough, with several kinds of deposits—numerous smaller and larger, rounded or oval bodies of a reddish-brown colour, aggregated into closely lying groups; numerous long fusiform straight or slightly curved rods with the centre slightly enlarged and perforated, but without any central process; smaller, more scattered, irregular perforated plates with two or more shorter arms, and with a long central process directed straight outwards from the body; and spoon-like rods, with one end enlarged and perforated, collected into groups of six to seven in each, and overlapping one another with the enlarged ends, each group presenting thus the aspect of a star. From the centre of these stars, which are very scattered, a long central anchor-shaped rod rises, directed straight outwards and supported by a round perforated disk-like base. Length of the individual about 75 mm. Colour in alcohol greyish-violet with numerous reddish-brown spots; the foremost and hindmost portions of the body whitish-grey.

Habitat:—Station 310, January 10, 1876; lat. 51° 27′ 30″ S., long. 74° 3′ W.; depth, 400 fathoms; bottom temperature, 46°5; blue mud; a single individual.

This species, doubtless very nearly related to the three previously known forms of the same genus, viz., *Ankyroderma jeffreysii* and *Ankyroderma affine*, Danielssen and Koren, and *Ankyroderma roretzii*, v. Marenzeller, differs from them particularly in the possession of the numerous very long smooth fusiform bodies as well as in the shape of the central anchor-rod of the star-like deposits, which is supported by a disk-like perforated base.

The reddish deposits (Pl. II. fig. 6, *h*) resemble those in *Trochostoma violaceum*, though generally smaller. The fusiform rods (Pl. II. fig. 6, *d*) also bear a strong resemblance to those in the species just mentioned. Having a length of as much as 1·4 mm. or more, they are very closely crowded side by side in the anterior and posterior portions of the body, while at the middle of the body they are more separated from one another as well as of a more irregular form. They are quite smooth, and their enlarged centre is pierced by three to nine holes of varying size. Sometimes a third arm runs out from the centre; as a rule, these fusiform or three-armed deposits appear to be more irregular than is the case in *Trochostoma violaceum*.

The smaller, perforated plates (Pl. II. fig. 6, *e*) are scattered among the former and present a very irregular shape. Generally they are of a more or less rounded or oblong form, with two to four or more short arms or sometimes without such. Reaching a length or diameter of about 0·4 mm., they always carry a long simple central process, the top of which carries some spines. Here and there some very minute deposits are to be found provided with a comparatively long central process which carries at its top several hooks (Pl. II. fig. 6, *f.g.*). The spoon-like deposits (Pl. II. fig. 6, *a*) and their mutual position will be best understood by a glance at the figures. They are generally aggregated, five to seven in each group, so as to present the appearance of stars. Each such aggregation is provided with a very long, straight, outwardly directed rod, the base of which (Pl. II. fig. 6, *b*) is round, discoidal, perforated and slightly convex upwards. These central rods are mostly broken off, but when uninjured their tops have the form of anchors with the flukes provided with three or more distinct serrations, thus resembling the anchors found by Danielssen and Koren in *Ankyroderma jeffreysii* and *Ankyroderma affine* (Pl. II. fig. 6, *c*).

Ankyroderma simile, n. sp. (Pl. II. fig. 5; and Pl. XI. fig. 2).

Body fusiform, anteriorly truncated, posteriorly decreasing into a narrow caudal portion. Tentacles fifteen, comparatively large, and provided with a pair of minute processes near the rounded ends. Anus surrounded by five calcareous teeth and fifteen minute cylindrical papillæ, disposed in groups of one tooth and three papillæ in each. Calcareous deposits very scattered—small rounded reddish or light brownish bodies mostly aggregated into smaller masses; small and thinly scattered rings supporting a crown of three to four straight outwardly directed rods; and very thinly dispersed star-like deposits, consisting of about five spoon-like rods, with the enlarged perforated ends overlapping one another, and a long straight outwardly directed central rod, the top of which is provided with two curved arms thus bearing some resemblance to the anchors in *Synapta*. Colour in alcohol dirty grey and yellowish-brown. Length 100 to 110 mm.

Habitat.—Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; depth, 345 fathoms; bottom temperature, 41·1; green mud; a single individual.

With regard to the inner organisation, *Ankyroderma simile* agrees mostly with the species before known, wherefore I refer to the descriptions of them. The reddish deposits (Pl. II. fig. 5, *c*) are of a more circular form, and considerably smaller than in the other species. The second kind of deposits (Pl. II. fig. 5, *d*) is also of a more insignificant size, and consists of an almost circular disk which is convex outwards, and pierced by three to four holes; from the convex surface of the disk a crown rises, composed of two to four straight or irregularly curved rods which are directed outwards and connected with one another by one or more transverse beams. The diameter of these deposits, which are very scattered, is only 0·064 mm. or less. However, near the posterior extremity of the body the deposits in question become more crowded and present a more irregular elongate form (Pl. II. fig. 5, *e*).

The star-like aggregations of deposits (Pl. II. fig. 5, *a*) are very scattered, and consist of five to six spoon-like rods with the enlarged perforated extremities overlapping one another, and with the handles often uneven, pierced by some minute holes, and split at their ends. Length of the rods up to 0·48 mm. The central anchor-shaped rod runs out from a small basal ring (Pl. II. fig. 5, *b*), and measures in length about 0·4 mm. or more; the flukes are mostly broken off, and appear to be highly curved and rather rough. The teeth which surround the anal aperture are composed of a firm network.

Ankyroderma marenzelleri, n. sp. (Pl. III. fig. 1).

Tentacles fifteen (?), each with three processes, the intermediate one being largest. Calcareous deposits of three different kinds; aggregations of larger and smaller, rounded or oval, yellowish or reddish-brown bodies; perforated plates with about six larger holes and with a long straight outwardly directed crown, composed of three rods connected with one another by several cross-rails, and split at their ends into several branched ends; and more scattered plates of a very singular form, pierced by several minute holes and provided with about three rather long arms. Besides a smaller crown of some spinous processes, these later deposits are always in connection with a straight outwardly directed anchor-shaped rod, the base of which is perforated and discoidal and the flukes provided with one or more serrations. Colour in alcohol, reddish-violet, dappled. Length about 26 mm.

Habitat.—Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms; bottom temperature, 40·0; blue mud; a single incomplete individual.

The tentacles are minute and retracted so that I am not quite sure of their number. The caudal portion of the body is broken off. The internal organs seem to be almost identical with those in the previously known species of *Ankyroderma*. The integument

is very rough from the numerous calcareous deposits. The plates, or rather tables, which are by far more numerous than the "anchor-plates," and give to the integument its roughness, have a diameter of up to 0·24 mm. or more. Besides these fully developed deposits, many others are imbedded in the skin representing the different stages of development of the former. The irregularly formed "anchor-plates" may be best understood from the figures; their length is about 0·4 mm. The bodies belonging to the two kinds of deposits above mentioned often have a yellowish-brown colour resembling that of the small rounded or oval bodies, and I have not seldom met with colourless deposits which have begun to change in this respect.

Genus *Trochostoma*, Danielssen and Koren, 1878 and 1882.

Trochostoma violaceum, Studer, 1877 (Pl. II. fig. 4; Pl. XI. fig. 1).

Habitat.—Royal Sound (Kerguelen Islands), 20 to 50 fathoms; numerous individuals. Betsy Cove (Kerguelen Islands), January 9, 1874; lat. 49° 16′ S., long. 70° 12′ E.; depth, 20 to 25 fathoms; one specimen. Christmas Harbour (Kerguelen Islands); depth, 120 fathoms; one specimen. Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms; bottom temperature, 40·0; blue mud; one specimen.

The body is fusiform, anteriorly truncated, and gradually decreasing in width towards the posterior end, which becomes rather narrow and is devoid of any processes or teeth. The tentacles, fifteen in number, are very short and provided with a pair of minute processes near their obtuse, round end; they communicate with fifteen long cylindrical tentacular vesicles or ampullæ. Each of the five longitudinal muscles is divided into two bands, and they do not give off any retractors. The calcareous ring (Pl. II. fig. 4, *d*) is built up of ten pieces, five radial and five interradial, which are intimately joined together so as to form a continuous whole. The interradial pieces, which are much smaller, send forwards one process, while the radial ones have two such, one of which is perforated for the nerves. Besides, the radial pieces terminate posteriorly in a large bifurcated process (Pl. XI. fig. 1, *a*), which supports the corresponding canal issuing from the water-vascular ring to the tentacles. Polian vesicle single, about 25 mm. long. The madreporic canal, single and dorsal, terminates in a madreporic tubercle. The reproductive organs are composed of two thin fascicles of long cylindrical sacs, one on each side of the medio-dorsal mesentery. The long common efferent duct opens externally slightly behind the tentacles, viz., between these and the madreporic tubercle. The cloaca communicates with two respiratory-trees, the right of which is generally longer, its cæcal end being often firmly attached to the gullet and the calcareous ring. The pseudhæmal vessels are not brought into connection with the respiratory-trees.

Three different kinds of deposits are to be found in the integument; large fusiform rods, which are sometimes changed into three-armed bodies (Pl. II. fig. 4, *b*); small irregular perforated deposits with a central process (Pl. II. fig. 4, *a*); and round or oval deposits of a wine colour (Pl. II. fig. 4, *c*). The fusiform deposits are very large, measuring up to 1·2 mm. or more in length, and mostly seem to have a transverse position; in the anterior and posterior parts of the body they are very numerous and closely crowded side by side, while at the middle of the body they are much scattered. Near the posterior end of the body the fusiform deposits often present a more irregular form, and it is here that the more or less irregular three-armed deposits are principally found. The slightly enlarged centre of these deposits is always pierced by some small holes. These deposits are quite smooth, and always devoid of spines or central processes. The deposits of the second kind are much smaller, about 0·4 mm. long, and very rare, and scattered so that they easily escape notice; they consist of a central, irregularly rounded or oblong, perforated disk with two or three arms and a central process, directed straight outwards from the body. The top of the process is often rough with minute spines. These deposits communicate to the integument a certain roughness, which, however, is very inconsiderable because of their rarity. The deposits of the third kind present a great variety of forms, from round to elongate or rather fusiform. The largest measure as much as 0·3 mm. or more. They are very numerous all over the body, and present a distinct concentric structure. They are of a brownish or reddish colour, like wine. The largest individual measures as much as 160 mm.

The specimen, brought home from Station 169, agrees, as it seems, in most points with the species of Studer. However, it is smaller, only 70 mm. long, of a lighter colour, and has the anal aperture surrounded by small cylindrical papillæ apparently more than five in number. The tentacles are retracted so as to make it impossible to observe their true form. The deposits of a reddish colour like wine are smaller than in the typical forms. Possibly this individual belongs to a new species, but for the present, from want of necessary material, I must abstain from offering any opinion.

From the summary description given by Studer, Danielssen and Koren[1] have thought themselves justified in referring his species to *Trochostoma* (*Molpadia*) *boreale*, M. Sars. A comparison of the above description with those given by the authors just mentioned, as well as by Sars,[2] will prove clearly that the southern form is different from the northern one.

[1] Echinodermer fra den norske Nordhavs-Expedition, *Nyt Magazin f. Naturvidenskab.*, 1879, Bd. xxv. Hefte ii. pp. 124, 126.

[2] Oversigt af Norges Echinodermer, Christiania, 1861, pp. 116–124, pls. xii., xiii.

Trochostoma antarcticum, n. sp. (Pl. II. fig. 7).

Habitat.—Station 306A, January 2, 1876; lat. 48° 27′ S., long. 74° 30′ W.; depth, 345 fathoms; bottom temperature, 46·0; blue mud; a single individual. Station 307, January 4, 1876; lat. 49° 24′ 30″ S., long. 74° 23′ 30″ W.; depth, 140 fathoms; bottom temperature, 46·0 blue mud; one specimen.

The specimen brought home from Station 306A has a length of about 40 mm. That dredged at Station 307 is much smaller. The only difference I have been able to observe between these forms and the species of von Marenzeller living in the Arctic Sea is found in the calcareous deposits, which are much more regularly constructed in the southern forms. From the scanty materials I must abstain, for the present, from offering any opinion on the validity of the new species proposed by me.

The caudal portion of the body is comparatively short but very narrow, especially in the smaller individual. Some very minute papillæ surround the anal aperture. The tentacles of the larger specimen have only three short processes, while those of the smaller individual seem to be furnished with about five. The tentacles being retracted, it is almost impossible to distinguish their true shape.

According to Danielssen and Koren, the old individuals of *Trochostoma arcticum* have their tentacles provided with five to seven processes, while the young ones carry but three such processes on each tentacle. The integument is thin, transparent, colourless, and very rough from numerous perforated calcareous tables consisting of a perforated disk and a straight outwardly directed long crown generally composed of three rods, which mostly carry spines and are connected with each other by several transverse beams. When fully developed, most of the disks of the tables have six larger holes and are of a more or less distinctly regular star-like form. Here and there a minute table may be found, composed of a triangular disk with three holes and a simple rod-like spire terminating in hooks (Pl. II. fig. 7, *d*). In the posterior part of the body the deposits present a more irregular shape, and often have some smaller holes besides the larger ones. Diameter of the plates up to 0·2 mm. or more. Many different stages in the development of these deposits are to be seen within the integument. No other kind of deposits is present.

Trochostoma albicans, n. sp. (Pl. III. fig. 2; Pl. XI. fig. 3).

Body elongated, anteriorly broadest, suddenly rounded and truncated, gradually tapering posteriorly into a very long slender, narrow, almost cylindrical caudal portion. Tentacles fifteen, short, with their terminal part rounded discoidal and surrounded by four or five short processes. Integument coriaceous or somewhat translucent, very rough, with only one kind of deposits, viz., numerous rather large and irregular perforated

plates, with numerous holes and a central crown built up of three rods. Colour in alcohol, whitish. Length of the largest specimen about 90 mm.

Habitat.—Station 45, May 3, 1873; lat. 38° 34′ N., long. 72° 10′ W.; depth, 1240 fathoms; bottom temperature, 37·2; blue mud; four specimens.

The posterior very narrow part of the caudal portion of the body is always broken off in all the individuals I have had at my disposal, but in the same bottle where they are kept, some caudal portions are left, probably belonging to the animals in question. They are about 30 mm. long, so that the largest specimen must be considerably longer than above noted, if one of these parts really belong to it. The anal aperture is surrounded by five calcareous teeth and a number of minute papillæ, the latter being disposed in a ring exteriorly and around the former. As in *Haplodactyla*, *Ankyroderma*, &c., no retractor muscles are present. The longitudinal muscular bands are divided throughout their whole length. The calcareous ring consists of ten pieces which are so united as to constitute a continuous whole; each radial piece is marked anteriorly by two shorter processes and posteriorly by a large bifid projection; the interradial pieces only possess a single shorter process in their anterior margin. Polian vesicle as well as the madreporic canal single. The respiratory-trees are two in number, with short branches; in one of the individuals the left tree is divided near its base into two parts. The genital tubes numerous, slender, and very narrow.

The calcareous deposits of the integuments are numerous, and especially in the caudal portion closely crowded. In most cases they present a somewhat triangular form, with three, seldom four, central holes larger than the remaining ones. The largest plates measure as much as 0·2 mm. in diameter. From the centre a crown rises, composed of three, seldom four, rods which become connected with one another by several cross-rails and terminate in several processes. The basal parts of these rods constitute the three or four central holes just mentioned, wherefore the plates, when the crown is broken off at the base, present a single large hole in their centre. The five teeth round the anus are formed by a firm calcareous network, and they seem to be provided with two rather long roots, by means of which they are firmly attached to the body-wall. According to Brandt,[1] the genus *Liosoma* as well as its species *Liosoma sitchaense* is characterised by having twelve peltate tentacles, and in 1857 Stimpson[2] describes another form, *Liosoma arenicola*, with fifteen tentacles composed of a short peduncle with four or five digitations at the disk-like summit; these branches being also minutely pinnate towards their extremities. No deposits are known from the integument of the two forms just mentioned. Thus the form of the tentacles should be the only characteristic of importance distinguishing *Liosoma* from, for instance, *Haplodactyla*, *Trochostoma*, and

[1] Prodromus, &c., 1835, p. 58.

[2] On the Crustacea and Echinodermata of the Pacific Shores of North America, *Journ. Boston Soc. Nat. Hist.*, vol. vi. 1857, pp. 85, 86 (extract).

other nearly related genera. Now, Ludwig[1] recently proved that the species of Brandt is identical with *Chirodota discolor*, Eschscholtz, and he also expressed the opinion that the whole genus *Liosoma* must be annulled. There is no doubt that *Trochostoma albicans* agrees most strikingly with regard to the shape of its tentacles with *Liosoma arenicola*, but at the same time its similitude to the genus *Trochostoma* being in all other points very obvious, I have thought myself justified in referring it to that genus. In conformity with the views of Ludwig, it appears to me that the genus *Liosoma* is founded on very secondary characteristics.

Trochostoma albicans, var. *glabra*, nov.

Habitat.—Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms; bottom temperature, 40·0; blue mud; a single individual.

Length of the individual, 115 mm. Colour in alcohol, whitish. The only difference existing between the type and its variety, as far as I know, is that the integument of the latter is almost smooth, the calcareous deposits being more scattered than in the former. The tentacles also seem to differ in some degree, their comparatively broad ends sending out on each side a very inconsiderable process, beneath which another pair of minute processes is visible.

Trochostoma sp. (?).

Habitat.—Station 299, December 14, 1875; lat. 33° 31′ S., long. 74° 43′ W.; depth, 2160 fathoms; bottom temperature, 35·2; blue mud; one specimen.

The calcareous deposits of the integument being in a state of dissolution, no description of their true form is possible. Only posteriorly in the caudal portion of the body are deposits left, exhibiting a shape almost identical with that common in *Trochostoma arcticum*, *Trochostoma boreale*, &c. They consist of a perforated disk with two arms, one on each side, and a central crown made up of three or four processes, which are mostly completely dissolved. No coloured deposits are to be seen. Possibly other forms of deposits have existed, though they are dissolved by some impurity in the alcohol. The tentacles are fifteen, retracted, each provided with, as it seems, two small processes. All the internal organs resemble those in the before mentioned species. Colour in alcohol, whitish, inclining to violet. Length about 85 mm.

Trochostoma (?).

Habitat.—Station 309, January 8, 1876; lat. 50° 56′ S., long. 74° 15′ W.; depth, 40 to 140 fathoms; blue mud; fragment of one individual; its generic as well as specific position were impossible to determine.

[1] Revision der Mertens-Brandt'schen Holothurien, 1881, pp. 581–583.

Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom temperature, 37·2; green sand; an incomplete specimen.

Caudina coriacea, Hutton, 1872 and 1879.

Habitat.—Station 167A, June 27, 1874; lat. 41° 4′ S., long. 174° 19′ E.; Queen Charlotte Sound, near Long Island; depth, 10 fathoms; mud; caudal portions of several individuals.

Only larger or smaller parts of the caudal portions of the body having been left, no complete diagnosis is possible, and for the same reason I cannot be quite sure of the genus to which it belongs. The integument is very firm, coriaceous, and hard, from numerous closely crowded deposits. Anus is surrounded by five groups of elongate papillæ, each group with five to seven papillæ. The supporting calcareous substance of one of these papillæ of each group seems often to be more developed and transformed into a kind of tooth built up of a dense and firm network.

The deposits of the body-wall strikingly resemble those in *Caudina ransonnetii*, v. Marenzeller (Pl. III. fig. 4); their diameter is as much as 0·052 mm. The deposits of the anal papillæ differ in a striking manner from those pertaining to the rest of the body. There seems to be but little doubt that these fragments belong to the species of Hutton dredged at the same locality. Having had the opportunity to examine the deposits of his types, I can confirm that they closely resemble those found in the Challenger specimen and those described by v. Marenzeller. I should not hesitate to refer Hutton's and the Challenger specimens to *Caudina ranzonnetii*, but v. Marenzeller does not mention the presence of the anal papillæ with their characteristic deposits (Pl. III. fig. 4*c*.).

SURVEY OF THE GENERA AND SPECIES, HITHERTO KNOWN, REFERRED TO THE APODOUS PNEUMONOPHORA.

Family II. Molpadidæ.

Tentacles simple, unbranched or digitate. Body tapering posteriorly into a narrow, longer or shorter caudal portion. Deposits of various shapes; anchors of a strange appearance very seldom occur, never wheels.

Genus 1. Ankyroderma, Danielssen and Koren, 1879 and 1882.

Retractor muscles absent. Calcareous ring with five bipartite posterior prolongations. Tentacles fifteen, three-lobed. Deposits—excepting other calcareous bodies, anchors in connection with groups of spoon-like rods, or very seldom irregularly formed anchor-plates.

Ankyroderma jeffreysii, Danielssen and Koren, 1879 and 1882.

Deposits of three kinds—groups of five to six spoon-like rods arranged so as to form a star, with the enlarged perforated ends forming the centre of the star and supporting an anchor with a very long shank or handle and slightly serrated flukes; tables with the irregular perforated disk more elongate at the extremities of the body, and with a spire, three-armed at the base, terminating in a few spines; finally numerous small round or elliptical wine-red bodies of a concentric structure.

Habitat.—Northern coast of Norway and the Arctic Sea, north of Norway; depth varying from 127 to 459 fathoms (Danielssen and Koren), Barents Sea (Hoffman).

Ankyroderma affine, Danielssen and Koren, 1879 and 1882.

Deposits of four kinds—stars with anchors, like those in the preceding species, but more numerous and arranged in nearly regular rows; tables like those in the preceding species, but much more irregular; spicules consisting of several (five to eight) slender arms radiating from a common centre, which carries an outwardly directed process or spire; finally, very rare, minute wine-red bodies.

Habitat.—Arctic Sea, between Norway and Beeren Island, at a depth of 191 fathoms (Danielssen and Koren).

The fifth kind of deposits, viz., the conglomerates of calcareous grains and prisms, may probably be the result of artificial processes.

Ankyroderma roretzii (*Haplodactyla*), von Marenzeller, 1878 and 1881.

Deposits of four kinds—stars like those in the preceding species, but no anchors are observed; perforated, more or less irregular, round cups, each with a very long process, which either is solid and simple, or provided with holes, and as it were composed of three rods; a layer of brown, round or elliptic bodies of concentric structure; these brown bodies are wanting at the tail, where they are supplied with crowded tables consisting of a fusiform or rounded perforated disk, and a tripartite spire terminating in several spines.

Habitat.—Japan (von Marenzeller).

Though no anchors have been observed, such deposits may, nevertheless, be found, and I cannot avoid thinking that the "cups" with the long process, according to von Marenzeller always broken off, represent simply the basal parts of the anchors. My own researches into the Challenger material seem to confirm this supposition. I cannot fully understand the descriptions of Danielssen and Koren, according to which that part of the anchor-stocks, which is in communication with the star-like deposits, is "furnished with linear apophyses, five to six in number, according as the stellate figure consists of five or six calcareous rods." This species is very nearly related to *Ankyroderma jeffreysii* and may possibly be only a variety of it.

Genus 2. Eupyrgus, Lütken, 1857.

Retractor muscles absent. Calcareous ring without posterior prolongations. Tentacles fifteen, simple, unbranched. Body-wall very rough. Deposits—crowded tables consisting of a large irregularly rounded or triangular disk with undulated margin, and perforated with numerous, twenty or more, round holes; the spire is long conical, built up of three rods, running together so as to form a conical finely spinous top, and several (not exceeding four) transverse beams.

Eupyrgus scaber, Lütken, 1857; Semper, 1868. *Echinosoma hispidum*, Semper, 1868.

Habitat.—Arctic Sea, north of Norway (Danielssen and Koren), Nova Zembla and Kara Sea (Stuxberg), Barents Sea (D'Urban), Spitzbergen (Ljungman, Danielssen and Koren), Greenland (Lütken, Ludwig, &c.).

(Mus. Holm.) A great number of individuals from Greenland and Spitzbergen. Some of the radial pieces of the calcareous ring seem to have a very indistinct and ground bifurcation posteriorly.

Genus 3. Haplodactyla, Grube, 1840.

Retractor muscles absent or rudimentary. Calcareous ring with five bipartite posterior prolongations. Tentacles fifteen to sixteen, simple unbranched. Body-wall not rough. Deposits of simple structure, never in the shape of tables.

Haplodactyla molpadioides, Semper, 1868.

Body-wall thick, not transparent. Deposits—numerous small, irregular button-like bodies; and roundish thick bodies strongly furrowed round the periphery and with some minute central holes. Five small branched papillæ round the anus.

Habitat.—Bohol and Zebu (the main form), Bohol (var. *pellucida*), China (var. *sinensis*), and Singapore (var. *jagorii*) (Semper).

As is seen above, the following varieties are referred by Semper to this species:—var. *pellucida* and *jagorii*, both devoid of deposits in the perisoma, and var. *sinensis*. All these varieties, however, are not well known.

Haplodactyla australis, Semper, 1868. *Haplodactyla holothurioides*, Selenka, 1868.

Body-wall not transparent. Deposits—small flat elongated bodies or grains, with the ends slightly enlarged. Anal papillæ absent (?).

Habitat.—Waigou (Selenka), Timor and Padang (Ludwig).

Haplodactyla hyaloeides, Sluiter, 1880.

Body-wall thin transparent. Deposits only present in the five short anal-papillæ and their vicinity, where they have the aspect of branched spicules.

Habitat.—Batavia (Sluiter), Amoy (Ludwig).

Sluiter speaks of retractors, but these are probably very rudimentary, and, as usual in forms with no retractors or only minute ones, uniting only the calcareous ring with the most anterior portion of the longitudinal muscular bands; Sluiter himself could not observe their attachment to the longitudinal muscular bands.

The following three forms are unsatisfactorily known and need re-examination:—

Haplodactyla holothurioides (*Molpadia*), Cuvier, 1817; Semper, 1868.

Deposits absent in the body-wall.

Habitat.—Atlantic Ocean (Semper).

Haplodactyla mediterranea, Grube, 1840; Semper, 1868; Ludwig, 1879.

Habitat.—Mediterranean Sea (Grube).

Haplodactyla musculus (*Molpadia*), Risso, 1826; Semper, 1868; Ludwig, 1879.

Habitat.—Mediterranean Sea (Risso).

Genus 4. Trochostoma, Danielssen and Koren, 1877, 1882.

Retractors absent or rudimentary. Calcareous ring with five bipartite, posterior prolongations. Tentacles fifteen, branched, digitate. Anus often with teeth-like papillæ. Body-wall mostly rough. Deposits—ellipses of a reddish colour and concentric structure alone; or tables alone; or both kinds together.

A. Deposits—Ellipses and Tables.

Trochostoma boreale (*Molpadia*), Sars, 1859, 1861; Danielssen and Koren, 1882. *Molpadia oolitica*, Selenka, 1867 (*partim*). *Haplodactyla oolitica*, Semper, 1868 (*partim*).

Tentacles with three (?) digits. Deposits—small red, crowded ellipses; tables composed of an irregular network of a triangular or rounded form representing the disk with large holes and carrying a spire terminating in two slightly spinous tops; tables having the disk elongate fusiform with some central holes, and a spire terminating in a single slightly spinous top, these being present in greater number at the ends of the animal.

Habitat.—Finmark (Sars), Barents Sea (Hoffman), Kara Sea (Stuxberg), Florida Reef (Pourtalès).

(Mus. Holm.) Numerous specimens from the Arctic coast of Siberia. As it seems to me, each short tentacle has a very short, broad, middle digit, and a narrower on each side, thus three digits. Anus with five (?) short papillæ. The red bodies in the perisome seem mostly to be collected in groups.

Trochostoma thomsoni, Danielssen and Koren, 1878, 1882.

Several localities south and north of the Arctic circle in the North Atlantic Ocean, at depths from 136 to 658 fathoms (Danielssen and Koren).

So far as I can discover, this form must be very nearly allied to the former, and it seems to me almost impossible to point out any difference of such importance as to justify their separation into two distinct species. I do not think the very inconsiderable differences in the conformation of the deposits, &c., sufficient to establish a new species.

Trochostoma violaceum (*Molpadia*), Studer, 1877. *Trochostoma boreale*, Danielssen and Koren, 1879, 1882 (*partim*).

Tentacles with three short digits. Deposits—round or elongate reddish bodies of a concentric structure; very large, smooth fusiform rods or three-armed bodies without spire, but with a few holes at their middle; and small, very few scattered

tables composed of an irregular two- or three-armed network representing the disk and carrying a central slightly spinous process.

Habitat.—Kerguelen Island (Studer).

The species mainly differs from the preceding ones in the very large, fusiform or three-armed deposits without spires, present all over the body though in larger numbers at its extremities.

Trochostoma turgidum (*Molpadia*), Verrill, 1879.

Tentacles two-lobed. Deposits—round or oval orange-brown bodies of a concentric structure; large irregular table-shaped plates consisting of a perforated disk with a central circle of three to six holes and an outer of ten or more larger oval holes, and a central spire built up of three to four columns.

Habitat.—Southern coast of New England, Fundy Bay, Massachusetts Bay, Gulf of Maine, Casco Bay; off Nova Scotia, Gulf of St. Lawrence (Verrill).

Verrill does not mention anything about anal papillæ. From the description it is impossible to understand what is the meaning of "with two-lobed tentacles," either there really are only two digits or the two lobes are situated below the top of the tentacles, in which case the tentacles are three-lobed as in the preceding species. Possibly the species is identical with *Trochostoma boreale*, Sars, which is distinguished mainly by its tables being much more irregular and smaller.

B. Deposits—tables alone.

Trochostoma arcticum (*Haplodactyla*), von Marenzeller, 1878; Danielssen and Koren, 1879, 1882.

Tentacles with five to seven digits; in young only three digits. Tables almost like those in *Trochostoma boreale*.

Habitat.—Finmark (Danielssen and Koren), north of Nova Zembla (von Marenzeller). (Mus. Holm.) One specimen from the Kara Sea. The tables consist of a very irregular disk and a short spire. The disk consists of longer or shorter, branched or simple arms, running out irregularly from a common centre; these arms are either united with each other so as to form a disk with a few large holes, or they remain free, thus constituting a disk resembling a branched spicule. The spire consists of a simple shorter central rod, which often terminates in a few spines. Towards the extremities of the body the tables change their shape, their disk being elongate, more like true disks, and provided with more holes, and their spire being composed of about three rods intimately united with each other, so that the spire often gives the impression of being a simple column; the top of the spire terminates in several teeth.

C. Deposits—reddish-brown, concentric bodies alone.

Trochostoma oolitieum (*Chirodota*), Pourtalès, 1851; Danielssen and Koren, 1878, 1882. *Holothuria pentactes*, Gould, 1841 (according to Pourtalès). *Molpadia oolitica*, Selenka, 1867 (*partim*). *Haplodactyla oolitica*, Semper, 1868 (*partim*).

Habitat.—Massachusetts at Boston (Gould, Pourtalès, Selenka), Block Island south of Cape Cod, and Boon Island (Verrill).

Neither in the papers of Danielssen and Koren and Sars, nor in those published by Pourtalès, have I found any direct statement of the conformation of the tentacles in *Trochostoma boreale* and *Trochostoma oolitieum;* but Danielssen and Koren, who referred these species to *Trochostoma*, distinguish the named genus from *Haplodactyla*, by its having digitate tentacles and the integument mostly rough. For my own part I do not believe these characters to be of much importance, and the more so as several species of *Trochostoma* have very rudimentary digits, evidently forming a transition to *Haplodactyla* with its simple tentacles, and, besides, two species of *Trochostoma* have the skin smooth. Further investigations may prove whether the specific characters above cited be true, or only of varietal significance, or due to difference of ages or sex.

D. Deposits in the perisoma, absent.

Trochostoma arenicola (*Liosoma*), Stimpson, 1857.

Habitat.—San Pedro in California (Stimpson).

Each of the fifteen tentacles "is composed of a short peduncle with four or five digitations at the disk-like summit." With regard to the deposits, Stimpson says: "The genus differs from *Chirodota* in the want of the calcareous deposits in the skin so characteristic of the later form." Numerous specimens of a *Trochostoma* are preserved in the State Museum of Stockholm, dredged at the same locality in California, which, in external appearance, are almost like the preceding northern species, and doubtless are just the same forms as that examined by Stimpson. They are of about the same body-form as, for instance, *Trochostoma boreale* and *Trochostoma arcticum*, &c., but possibly more swollen at the middle of the body. They resemble the above named species in internal and external organisation, but seem to be totally devoid of deposits in the perisome. The tentacles are completely retracted in all specimens, consequently it is not possible to state their true appearance, but they evidently bear some short digits. Integument thick, smooth, leathery. Calcareous ring with five bifurcate prolongations posteriorly. The retractors absent, but traces of such present where the longitudinal muscular bands join the calcareous ring.

Genus 5. Caudina, Stimpson, 1853, von Marenzeller, 1881.

Retractor muscles absent. Calcareous ring with five bipartite posterior prolongations. Tentacles twelve to fifteen, digitate (or terminating in a disk ?). Caudal portion very long and narrow. Deposits—circular perforated disks or cups.

Caudina arenata (*Chirodota*), Gould, 1841; Pourtalès, 1851; Stimpson, 1853; Ayres, 1854; Selenka, 1867; Semper, 1868; von Marenzeller, 1881; Kingsley, 1881.

Tentacles fifteen, each with about four digits. Deposits—rounded circular disks with slightly undulating margin, and perforated with eight to twelve holes arranged round a central opening which often seems to be quadrifid.

Habitat.—Chelsea Beach near Boston (Gould, Pourtalès, Verrill, &c.), Massachusetts Bay (Verrill, Stimpson), Vineyard Sound to Chelsea (Verrill), Grand Manan (Ludwig, Selenka), Revere Beach, Mass. (Kingsley).

The accounts of the tentacles in this species are various, Gould only found eleven; Selenka and Ayres assert them to be twelve; Pourtalès has observed their number to be fifteen, each divided into five lobes; and, finally, von Marenzeller, who has had the opportunity of examining numerous specimens, states them to be fifteen, each with four digits, of which two at the top are minute.

Caudina ransonnetii, von Marenzeller, 1881; Ludwig, 1883.

Tentacles fifteen, like those in the preceding species. Deposits—regularly perforated very flat cups with outwardly, upwardly directed teeth in the margin; the opening of the cups is closed by an × -shaped figure with low-knobs in the centre and at the ends of the arms.

Habitat.—Yellow Sea (von Marenzeller), Japan (Ludwig).

Caudina coriacea (*Molpadia*), Hutton, 1872 and 1879. *Echinosoma* (*?*) *coriacea*, Hutton, 1879. *Caudina meridionalis*, Bell, 1883.

Habitat.—Wellington, New Zealand (Hutton, Bell).

The description of Hutton is too summary to communicate an idea of the animal in question. However, in the State Museum of Stockholm I have seen two specimens dredged at Wellington and presented by Hutton under the name of *Molpadia coriacea*. Hence I am able to state the correctness of the synonymy, and, though I could not examine the tentacles, I venture the suggestion that Hutton's species is identical with, or, at least, very nearly allied to, the above species of von Marenzeller. The absence of true retractors, the long tail, and, above all, the characteristic deposits, speaks for this close relation. However, there may exist some small differences in the shape of the calcareous ring, the bifurcate prolongations of the radial pieces being slightly longer and more slender in the

specimen from New Zealand. A re-examination and comparison of both forms is necessary. Even the deposits of the New Zealand form are not exactly like those figured by von Marenzeller, their margin bearing mostly roundish knobs instead of teeth; but I even found deposits with more conical teeth-like knobs in the same species.

Caudina caudata (*Microdactyla*), Sluiter, 1880; Ludwig 1883.

Tentacles twelve, terminating in a small disk. Deposits, resembling those in *Caudina ranzonnetii*, consisting of regularly perforated cups with teeth in the margin, and with the opening closed by an ×.

Habitat.—Sunda Strait (Sluiter).

Ludwig feels himself inclined to refer this species to *Caudina ranzonnetii*, but, if so, the description of Sluiter must be very incorrect. Indeed, the figures of the tentacles are very remarkable, and there seems to be but little doubt that they are incorrectly drawn and understood. On the other hand, his statement of the number of tentacles may probably be right, and the calcareous cups of the respective species differ from one another in an obvious manner. However, *Caudina caudata* may be ranged among the unsatisfactorily known forms.

Genus 6. Molpadia, Cuvier, 1817; Semper, 1868.

Retractor muscles present. Calcareous ring with five bipartite posterior prolongations. Tentacles twelve to fifteen, branched, digitate. Calcareous deposits—knobbed or spinous, perforated, roundish button-like disks.

Molpadia chilensis, J. Müller, 1850, 1854.

Tentacles twelve to fifteen, each with four digits. Deposits—very regularly formed, rounded buttons with symmetrically arranged rounded knobs and four central holes.

Habitat.—Chili (Müller).

Molpadia australis, Semper, 1868.

Tentacles fifteen, with four digits. Deposits irregularly formed, roundish buttons with asymmetrically placed (up to seven) holes, and with short spines in the margin as well as on their surfaces; besides, scattered calcareous rods in the deeper layer of the skin.

Habitat.—Rockhampton (Semper).

Genus 7. Embolus, Selenka, 1867.

Retractor muscles absent. Calcareous ring absent. Tentacles fifteen. Deposits—brownish-red ellipses of concentric structure.

Embolus pauper, Selenka, 1867 ; Pourtalès, 1868.

Habitat.—(?) Cape Palmas (Selenka).

The genus and species seem to be uncertain. Pourtalès says: "One of the specimens sent from the Cambridge Museum to Mr. Selenka had received by some accident the label of 'Cape Palmas (?)' and on this one he has based his new genus *Embolus*. I am perfectly satisfied that the *Embolus pauper*, Selenka, is the same thing as *Molpadia oolitica*. The figures he gives of the œsophageal ring of *Molpadia oolitica* and of a calcareous grain of *Embolus pauper* are both taken from specimens of *Molpadia oolitica*. The absence of the œsophageal ring in the specimen he examined is accidental, as is also the absence of the tail-like prolongation of the anal extremity of the body." Thus, this genus and species must probably be omitted.

In general, the distinguishing characters of the genera of this family are mostly of slight importance, and further investigation will probably result in a diminution in the number of genera as well as of species.

Order II. PEDATA.

Body of various shapes, provided with pedicels or papillæ, the latter often situated on the top of larger or smaller protuberances. Tentacles dendroid or peltate. Respiratory-trees present.

Family DENDROCHIROTÆ.

Subfamily STICHOPODA.

Genus *Cucumaria*, Blainville, 1834.

Cucumaria lævigata, Verrill, 1876 (Pl. III. fig. 5; Pl. VI. fig. 13).

Habitat.—Station 149B, Kerguelen Islands, January 17, 1874; lat. 49° 28′ S., long. 70° 30′ E.; off Royal Sound; depth, 25 fathoms; numerous individuals: January 29, 1874; off Christmas Harbour; depth, 120, 105, and 45 fathoms; numerous individuals. Station 151, February 7, 1874; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ E., off Heard Island; depth, 75 fathoms; volcanic mud; a single specimen.

The specimens examined by me do not quite agree with the description given by Verrill, but, considering that the Challenger specimens were dredged in great numbers on the very same localities in which Verrill, Studer, and Smith state that *Pentactella lævigata* is "very common," there seems to be not the least doubt of their identity.

The body is fusiform, more or less elongated. The largest individuals, though contracted, have a length of as much as 115 mm. or more. The tentacles are almost without exception of equal size; only in a very few individuals are they unequal, some dorsal or ventral ones being smaller than the rest, and it is worthy of note that these smaller tentacles are not fixed in position, as is the case in the typical *Cucumariæ*. The anus is destitute of any teeth. The Polian vesicles are three to five, rather long, but in some individuals only one vesicle of considerable size is visible, while the others are very rudimentary. The retractor muscles issue from the longitudinal muscular bands near the middle of the body or nearer its posterior end. The genital tubes are simple. The pedicels of the bivium and trivium are almost equally large, and arranged in a double alternating row along each ambulacrum. No pedicels are found on the interambulacral spaces. In the smaller individuals the pedicels at the middle of the body are more scattered, so as to give the impression of being disposed in a single zigzag row.

According to Verrill, this species should be destitute of any calcareous ring, for

which reason he referred it to a new genus, *Pentactella*, but in this point I cannot agree with him. Among the specimens examined by me only the largest ones seem to want the calcareous ring; often it is very rudimentary, and never becomes visible without treatment with a solution of potash. In the smaller individuals it is more developed than in the larger. The five radial pieces of the ring (Pl. III. fig. 5, *a*) are more developed than the interradial, which mostly are very inconsiderable. As to its general appearance, the ring presents a certain resemblance to that in *Cucumaria crocea*, though in a much lower state of development.

With a few exceptions, all the individuals from Royal Sound and Betsy Cove are almost devoid of any calcareous deposits; this, however, seems to depend upon some impurity in the alcohol by which they have been dissolved. Thus, nearly all the larger specimens from these localities are totally devoid of deposits excepting in the pedicels. Only in a few forms of a more considerable size the deposits are left, but always in a more or less advanced state of solution, a fact from which I conclude that even the other individuals were provided with deposits, but that they have already been fully dissolved. The smaller forms, on the contrary, seem to resist the influence of an acid for a longer time, because most of them, kept in the same bottles, have their deposits left. At first I was almost tempted to think that I had to work with two different species, though living at the same localities, but having found some larger specimens with deposits in a state of dissolution, I cannot doubt that the smaller forms are only young of the larger. If, however, it should be proved that the largest specimens are destitute of deposits, it cannot cause surprise, considering the known fact that the larger forms of *Cucumaria frondosa*, for instance, are almost entirely devoid of deposits, while others are in possession of such.

The deposits (Pl. III. fig. 5 and Pl. VI. fig. 13) have the form of irregular plates which are rounded, oval, or more or less elongate. They are scattered, and perforated by four to twelve holes, of which the four central are larger, and their upper surface is provided with small knobs or spines. The largest plates have a length of about 0·18 mm. Besides these deposits, the integument contains small ×-shaped bodies, which, however, are only developmental stages of the former. The pedicels are strengthened by a well-developed terminal plate, and by some branched spicules and smaller plates resembling those in the body-wall itself. Even in the pedicels of the larger specimens, which are destitute of deposits in the perisome, such deposits are present. There is no doubt that *Cucumaria lævigata* bears the nearest resemblance to the northern form, *Cucumaria frondosa*.

Cucumaria crocea, Lesson, 1830 (Pl. XII. figs. 1, 2).

Habitat.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom temperature, 47°·8; sand; a few specimens. Station 314,

January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom temperature, 46°·0; sand; one specimen. Station 315, January 26, 27, 28, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms; sand and gravel; very numerous specimens. Station 316, February 3, 1876; lat. 51° 32′ S., long. 58° 6′ W.; depth, 4 to 5 fathoms; mud; one specimen.

During his stay at the Falklands, Sir Wyville Thomson[1] paid special attention to this very interesting form, and it may be permitted to cite his own words:—"Adhering to the fronds of *Macrocystis* there were great numbers of an elegant little cucumber-shaped sea-slug (*Cladodactyla crocea*, Lesson), from 80 to 100 mm. in length by 30 mm. in width at the widest part, and of a bright saffron-yellow colour. The mouth and excretory opening are terminal; ten long, delicate, branched oval tentacles, more resembling in form and attitude those of *Ocnus* than those of the typical *Cucumariæ*, surround the mouth; the perisoma is thin and semitransparent, and the muscular bands, the radial vessels, and even the internal viscera can be plainly seen through it. The three anterior ambulacral vessels are approximated, and on these the tentacular feet are numerous and well developed, with a sucking-disk supported by a round cribriform calcareous plate, or more frequently by several wedge-shaped radiating plates arranged in the form of a rosette; and these three ambulacra form together, at all events in the female, a special ambulatory surface.

"The two ambulacral vessels of the 'bivium' are also approximated along the back, and thus the two interambulacral spaces on the sides of the animal, between the external trivial ambulacra and the ambulacra of the bivium, are considerably wider than the other three; consequently, in a transverse section, the ambulacral vessels do not correspond with the angles of a regular pentagon, but with those of an irregular figure in which three angles are approximated beneath and two above. In the female the tentacular feet of the dorsal (bivial) ambulacra are very short; they are provided with sucking-disks, but the calcareous supports of the suckers is very rudimentary, and the tubular processes are not apparently fitted for locomotion. In the males there is not so great a difference in character between the ambulacra of the trivium and those of the bivium; but the tentacles of the latter seem to be less fully developed in both sexes, and I have never happened to see an individual of either sex progressing upon, or adhering by, the water-feet of the dorsal canals.

"In a very large proportion of the females which I examined, young were closely packed in two continuous fringes, adhering to the water-feet of the dorsal ambulacra. The young were in all the later stages of growth, and of all sizes from 5 up to 40 mm. in length; but all the young attached to one female appeared to be nearly of the same age and size. Some of the mothers with older families had a most grotesque appearance, their bodies entirely hidden by the couple of rows, of a dozen or so each, of

[1] *Journ. Linn. Soc. Lond.*, vol. xiii. 1878, pp. 57–61.

yellow vesicles like ripe yellow plums ranged along their backs, each surmounted by its expanded crown of oval tentacles; in the figure the young are represented about half grown. All the young I examined were miniatures of their parents; the only marked difference was that in the young the ambulacra of the bivium were quite rudimentary—they were externally represented only by bands of a somewhat darker orange than the rest of the surface, and by lines of low papillæ in the young of larger growth; the radial vessels could be well seen through the transparent body-wall; the young attached themselves by the tentacular feet of the trivial ambulacra, which are early and fully developed.

"We were too late at the Falklands (January 23) to see the process of the attachment of the young in their nursery; even if we could have arranged to keep specimens alive under observation, there can be little doubt that, according to the analogy of the class, the eggs are impregnated either in the ovarial tube or immediately after their extrusion, that the first developmental stages are run through rapidly, and that the young are passed back from the ovarial opening, which is at the side of the mouth, along the dorsal ambulacra, and arranged in their places by the automatic action of the ambulacral tentacles themselves."

In order to complete the above description by Sir Wyville Thomson, the following remarks may be added:—As a rule, the tentacles in *Cucumaria* are unequal, two of the ventral ones being considerably smaller, but strangely enough, *Cucumaria crocea* appears to resemble the state in *Cucumaria frondosa*, &c., in having them equally large. The anus is devoid of teeth. Pedicels are only present in the ambulacra, where they are arranged in a double row along each. Sometimes this arrangement of the pedicels of the ventral ambulacra is slightly deranged, so that three instead of two rows are to be distinguished along each ambulacrum. The difference between the dorsal and ventral pedicels is very conspicuous, the former being more numerous and several times smaller. In the young, the size of the dorsal pedicels decreases gradually, so that in small individuals, from 20 mm. to 40 mm. long, no dorsal pedicels at all are to be seen. Besides, the smaller forms have only a simple row of pedicels on the ventral ambulacra, and it seems to be a rule that when the double rows of ventral pedicels are developed the dorsal ones begin to grow out.

The perisome is soft and very pliable, and does not contain any calcareous deposits, excepting in the tentacles and pedicels, the former being supported by scattered, small, perforated, irregular spicules or plates, the latter by a larger, well developed, round, perforated, terminal plate, with very numerous small holes, which is sometimes surrounded by small spicules. The calcareous terminal plates of the ventral pedicels are much larger than those of the dorsal pedicels, the former having a diameter of about 0·72 mm., the latter of only 0·38 mm. The Polian vesicle is single and rather large. The single, dorsal, madreporic canal winds upwards attached to the dorsal mesentery. In the largest specimens the retractor muscles are attached at a distance of about 25 mm. behind the

anterior extremity of the body, and in some individuals from Station 313 they communicate with the radial muscular bands at its middle. The calcareous ring is very narrow and fragile; when treated with a solution of potash it does not separate into distinct pieces, but seems to form a continuous whole. Anteriorly, it sends out ten comparatively long processes, of which the five radial are slightly enlarged at the tops and notched. The reproductive organs consist of two fascicles of long, slender, simple tubes, and its long efferent duct opens in a small papilla situated far behind the tentacles. Besides the two longer respiratory-trees, often one or two shorter ones are present.

The above description refers to the specimens dredged at Station 315. That obtained at Station 316 is totally devoid of any calcareous deposits, these having been probably dissolved by means of some impurity in the alcohol. The individuals, on the contrary, brought home from Stations 313 and 314 are remarkable for having the integument supported by some very scattered, irregular or almost round, perforated plates and more numerous larger and smaller spicules with the ends branched or perforated, resembling those found in the pedicels of the individuals from Station 315. The larger spicules measure as much as 0·22 mm. in length, the smaller about 0·08 mm., and the plates have a diameter of about 0·2 mm. or more. The plates as well as the rods are more or less spinous. In the individuals dredged at Station 313 the deposits are in a state of solution; which consideration renders it rather probable that the individuals from Station 315 have also been in possession of deposits in the body-wall, though they are dissolved. If this be so, I cannot conceive how it is possible that the terminal plates of the pedicels have been left. However, I have more than once observed that the calcareous ring as well as the deposits of the pedicels become dissolved later than the deposits of the body-wall itself.

Cucumaria crocea, Lesson, seems not to be identical with Semper's *Cucumaria godeffroyi*, but both forms are doubtless nearly allied to each other.

Cucumaria mirabilis, n. sp. (Pl. IX. fig. 5).

Body tapered towards each extremity, curved, with the convex ventral surface longer than the concave dorsum. Tentacles small, ten in number. Pedicels mainly belonging to the ambulacra, two or three rows in each, besides some scattered pedicels in the interambulacra. Excepting these pedicels, some slightly larger elongate conical processes are to be found on the ventral ambulacra. Deposits—crowded tables consisting of an irregularly perforated rounded or angular disk with uneven margin and a short spire built up of only two short rods; the top of the spire terminates in several spines; pedicels and processes with transformed, rod-like tables. Colour in alcohol, light yellowish-grey. Length about 12 mm. (in contracted state).

Habitat.—Zebu (Philippine Islands); depth, 100 fathoms; one specimen. Port Jackson (Australia); depth, 6 to 15 fathoms; one specimen.

The body of the animal being in a state of contraction, it is almost impossible to decide whether the curve of the body is a result of an accidental contraction or not. For the same reason the arrangement of the ambulacral appendages is not easy to determine. So far as I can discover, the pedicels are situated mainly on the ambulacra, where they are disposed in two to three rows. But even in the interambulacra a few scattered pedicels may be observed, especially on the dorsal surface, though the middle line of the interambulacra always seems to be naked; consequently the narrow interambulacra give the impression of being in want of pedicels. Strangely enough, the three longer, ventral ambulacra carry at the middle of the body some conical elongate papillæ, which seem to be in want of sucking-disks. This is contrary to what was stated by Semper in *Cucumaria versicolor*, which species is furnished with papillæ scattered among the dorsal pedicels.

The calcareous ring (Pl. IX. fig. 5, *a*) is composed of ten pieces, of which the five radial are prolonged into two narrow processes posteriorly, which, if my observations be right, are composed of several joints. A single Polian vesicle and madreporic canal present. The ampullæ are visible on the inner side of the body-wall. The reproductive organs are composed of two thick bundles of short simple tubes.

The tables of the perisome (Pl. IX. fig. 5, *b*, *c*, *d*) are characterised by possessing a spire composed of only two rods and by the want of a larger central hole in the disk; besides, the spire is short, without transverse beam, and terminates in several teeth. The diameter of the disk is from 0·04 to 0·05 mm., the height of the spire is about 0·028 mm. The pedicels and papillæ are supported by transformed, curved, rod-like tables (Pl. IX. fig. 5, *e*, *f*). The walls of the body itself, pedicels and papillæ, are rough with the deposits.

The specimen brought home from Australia closely agrees with the above description. Length, 13 mm. Its body-form is more rounded, with the ventral surface longer and more convex than the dorsal surface. Tentacles fully extended, two ventral smaller than the rest. Pedicels arranged in a double row on each ambulacrum, and, besides, scattered on the interambulacra, which, however, are almost naked at the middle of the body and along their middle line. The pedicels have well-marked sucking-disks. At the middle of the body the three ventral ambulacra carry some long, slender, almost cylindrical papillæ, which are totally devoid of sucking-disks, but terminate in a conical top without terminal plates. These "papillæ" are about 4 mm. long, thus being much larger than the pedicels.

Cucumaria capensis, n. sp. (Pl. V. fig. 2).

Body cylindrical, indistinctly pentangular, more tapered posteriorly than anteriorly. Arms without teeth. Tentacles ten, two ventral considerably smaller. Pedicels in a

double row along each ambulacrum. The interambulacra naked. Integument rather hard, with numerous deposits—small irregular, slightly concave, cup-like, perforate bodies with spines on the concave and knobs on the convex surfaces; closely disposed buttons of various shape, the more regular with about four holes and a smaller number of larger knobs; and large, scattered, thick, almost scale-like, round, elongate or oval plates with numerous holes and knobs. Pedicels strengthened by transverse plate-like rods with holes and a few knobs. Terminal plates less developed. Colour in alcohol, light greyish. Length about 53 mm.

Habitat.—Station 141, December 17, 1873; lat. 34° 41′ S., long. 18° 36′ E.; depth, 98 fathoms; bottom temperature, 49°·5; green sand; a single specimen. Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom temperature, 47°·0; green sand; two specimens.

The calcareous ring (Pl. V. fig. 2, *c*) is slender, of common form, without posterior prolongations. A single Polian vesicle and madreporic canal are present. The slender retractors are attached at about the first fourth of the body. The reproductive organs are composed of simple unbranched tubes. The respiratory-trees are not very richly provided with branches. The integument is not very thick or hard, and contains a multitude of deposits; the larger deposits communicate to the surface of the skin a punctulate aspect.

The flat cups (Pl. V. fig. 2, *a*) are situated in the exterior layer of the perisoma, and present themselves under very variable aspects; sometimes they are simply cruciform, mostly, however, plate-like, with two to five holes. Their upper, concave surface is always provided with spines, while the inner surface carries some knobs. Their diameter measures as much as 0·04 mm. The buttons (Pl. V. fig. 2, *b*) even vary greatly as to their shape, some being oval symmetrical, others, on the contrary, very symmetrical, with a greater number of lobes and knobs. The smaller, symmetrical, true buttons measure as much as 0·1 mm. in length. The scale-like plates (Pl. V. fig. 2, *c*) are not closely crowded as in the former, but scattered, and attain a considerable size, up to 0·8 mm. in diameter. They are firmly constructed, thick, with numerous holes and knobs. A series of transitional forms between the buttons and plates are to be found. The pedicels carry numerous, knobbed or smooth, perforated plates, and, plate-like, more or less curved rods (Pl. V. fig. 2, *d*). The terminal plates seem not to be very well developed.

As far as I can find, this species cannot be referred to any other *Cucumaria* before known; it bears, indeed, some resemblance to *Cucumaria planci* and *Cucumaria syracusana*, but the former seems to be in want of the large plates, &c., and the latter carries pedicels even on the interambulacra, &c. It may even appear as if this species is very nearly allied to *Cucumaria discolor*, which has been brought home from nearly the same locality, but the latter is distinguished by the stellate mouth, the almost equally large tentacles, the rounded cylindrical body-form, the very thick, leathery perisoma, and by

the colour, &c. Nevertheless, further examination may prove that *Cucumaria capensis*, *Cucumaria discolor*, and *Cucumaria planci* represent different types of one and the same species.

Cucumaria discolor, n. sp. (Pl. IV. fig. 8).

Body subcylindrical, without any marked demarcation between the dorsal and ventral surfaces. Tentacles retracted, ten of almost equal size. Mouth stellate. Arms without teeth, and the anal portion not caudiform. Ambulacral appendages only on the ambulacra, completely retracted, more numerous on the ventral surface. The ventral pedicels larger, arranged in a double row along each ambulacrum. The dorsal appendages seem to be of a more conical form, present, when retracted, considerably smaller openings, and may possibly be considered as "papillæ;" they are evenly arranged in double rows. Integument thick, leathery, with the surface smooth without any visible scales. Deposits—slightly concave, very delicately constructed, perforated plates or cups with numerous spines or knobs; crowded buttons larger than the former, with a varying number of holes and large knobs; rounded, compact reticulate thick scales of varying but never of any considerable size. A complete series of transitional forms between the buttons and scales occurs. Colour in alcohol, light brownish-violet, with larger and smaller darkish brown spots. Length, 70 mm.

Habitat.—Simons Bay; depth, 10 to 20 fathoms; a single specimen.

Not having had the opportunity of examining the dorsal ambulacral appendages in an extended condition, I am somewhat uncertain whether they may be referred to papillæ or pedicels. If they were to be considered as true papillæ, the species might belong to the genus *Colochirus*, which contains forms (*Colochirus spinosus* and *Colochirus inornatus*) presenting an undoubted relation to it. The ventral pedicels as well as the dorsal are in communication with ampullæ depending into the peritoneal cavity, but those of the dorsal pedicels are smaller. A single Polian vesicle and madreporic canal are present. The retractors are attached at about the middle of the body. A small muscular stomach is present. The genital organs are composed of two thick bundles of simple, rather long tubes. The respiratory-trees are of common shape. The ventral pieces of the calcareous ring are inconsiderably smaller than the rest, and the undulated posterior margin of the ring is devoid of any processes.

The calcareous deposits closely resemble those found in the two above cited, nearly related species. The exterior layer of the perisome contains numerous small, slightly concave, very delicately constructed perforated plates or cups (Pl. IV. fig. 8, *a*), with the margin uneven, and with numerous long spines or knobs on their upper and inner surfaces; they measure as much as 0·06 mm. in diameter. The buttons which lie beneath the former commonly grow larger, up to 0·09 mm. or more, but it is no rarity to find much smaller ones provided with only four holes and a smaller number of knobs

(Pl. IV. fig. 8, *b*). The scales are commonly roundish, compact and thick, almost resembling a mulberry (Pl. IV. fig. 8, *c*), and do not attain a greater diameter than about 0·7 or 0·8 mm. A whole series of transitional forms are to be found between the small buttons and these scales, which have evidently been developed from the former. The pedicels and papillæ are strengthened by plate-like perforated rods (Pl. IV. fig. 8, *d*) and terminal plates, the latter being slightly larger in the pedicels.

Cucumaria mendax, n. sp. (Pl. V. fig. 3; Pl. XVI. fig. 3).

Body cylindrical or fusiform. Anus without teeth. Tentacles ten, of almost equal size. Pedicels pretty closely disposed, equally distributed all over the body, without traces of any arrangement in rows. Surface of the perisoma almost smooth. Deposits numerous, crowded, of two kinds—round or oval, rather symmetrical buttons with about four holes and ten large knobs, and elongated more or less irregularly formed knobbed plates with as many as ten holes, one end being slightly narrower and provided with spines. Pedicels supported by terminal plates and crowded perforated plates or rods, often with some spines on the margin and knobs on the surfaces. Colour in alcohol, yellowish-white. Length of the largest specimen, about 70 mm.

Habitat.—Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms; sand and gravel; six specimens.

In the largest specimen, brought home from the above mentioned Station, the arrangement of the pedicels completely resembles that characteristic of the genus *Thyone*, and, at first sight, I even referred it to this genus, but, considering the general organisation, it doubtlessly presents the nearest relation to several species of *Cucumaria* before known. In the five other smaller individuals, on the contrary, an arrangement of the pedicels in rows is perceptible, and especially in the smallest, about 25 mm. long, specimens this arrangement becomes most distinct. Thus, the outer aspect of these small specimens is very like that in Semper's *Cucumaria koellikeri* and *Cucumaria dubiosa*, and Ludwig's *Cucumaria salmini*, but they present even a great conformity in their internal organisation, as will be seen further on.

The calcareous ring is of the ordinary shape, without prolongations posteriorly, though traces of such are distinguishable in some of the radial pieces. The madreporic canal is single, dorsal. Four Polian vesicles are present. The retractors are attached at the middle of the body or slightly in front of it. The genital tubes are simple, unbranched, as much as 40 mm. long. The respiratory-trees in comparison to the genital organs are not very richly developed.

On comparing the descriptions of Semper and Ludwig, it will be found that the deposits of *Cucumaria mendax* almost completely resemble those in the three above-mentioned species. The knobbed and spinous plates (Pl. V. fig. 3, *a*) are situated

exteriorly, and measure as much as 0·15 mm. in length, while the buttons (Pl. V. fig. 3, *b*), on the contrary, have a more constantly regular form and a length of about 0·1 mm.

Probably, it will at once be stated that the species in question is identical with one of the before-mentioned species, these being younger forms, but for the present I think it better to hold them apart.

The small individuals mainly differ from *Cucumaria salmini* by the want of anal teeth, from *Cucumaria dubiosa* by the fact that the pedicels are present even in the ventral interambulacra, and from *Cucumaria koellikeri* by the number of Polian vesicles and by the simple genital tubes. *Cucumaria dubiosa* is possibly a young individual of *Cucumaria koellikeri*.

Cucumaria abyssorum, n. sp. (Pl. IV. fig. 6; Pl. XVI. fig. 6).

Body inflated, fusiform, with the posterior extremity tapered, caudiform. Tentacles ten, of almost equal size. Anus without teeth. Pedicels completely retractile, thinly distributed in a double alternating row along each ambulacrum. The spacious interambulacra naked. Integument thin and soft, supported by scattered, rather large four-armed calcareous bodies with the ends of the arms dilated, spinous and pierced by some holes; one of these arms especially is more developed, provided with more spines, and communicates to the surface of the body a certain degree of roughness. Pedicels strengthened by terminal plates and straight or slightly curved rods with the ends dilated, perforated and spinous, and with a larger or smaller spinous process in the middle; sometimes this process is larger and perforated. Colour in alcohol, yellowish-white. Length, 45 mm.

Habitat.—Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom temperature, 34°·2; Diatom ooze; seven specimens. Station 156, February 26, 1874; lat. 62° 26′ S., long. 95° 44′ E.; depth, 1975 fathoms; Diatom ooze; three specimens.

The largest individual is remarkable in possessing only nine tentacles, but this can only be an abnormality. A single Polian vesicle and madreporic canal are present. The calcareous ring (Pl. IV. fig. 6, *a*) is not very well developed, and has no posterior prolongations. The retractors communicate with the muscular bands nearer the anterior end than the middle of the body. Anteriorly, the alimentary canal is provided with a very powerful, expanded, muscular stomach. The reproductive organs consist of short simple tubes arranged in a bundle on each side of the dorsal mesentery. The respiratory-trees have comparatively few and short branches, scattered all over their length.

The perisome is soft and pliable; its calcareous deposits (Pl. IV. fig. 6, *b*) are more thinly scattered. The diameter of the deposits measures 0·3 mm., and sometimes they bear some spines not only at the ends of the arms, but even in their middle.

It is characteristic of these deposits that one of the arms is always more developed and more richly furnished with spines and holes; and this arm is directed obliquely outwards. I do not know any species of *Cucumaria* provided with deposits like those in this abyssal form. The specimens obtained at Station 156 differ by the absence of deposits in the body-wall itself. These specimens, however, seem to be macerated and their deposits dissolved by some impurity in the alcohol. Possibly they are more nearly related to the variety *grandis*.

Cucumaria abyssorum, var. *grandis*, nov. (Pl. V. fig. 1).

Habitat.—Station 298, November 17, 1875; lat. 34° 7′ S., long. 73° 56′ W.; depth, 2225 fathoms; bottom temperature, 35°·6; blue mud; two specimens. Station 299, December 14, 1875; lat. 33° 31′ S., long. 74° 43′ W.; depth, 2160 fathoms; bottom temperature, 35°·2; blue mud; eight individuals. Station 295, November 5, 1875; lat. 38° 7′ S., long. 94° 4′ W.; depth, 1500 fathoms; bottom temperature, 35°·3; Globigerina ooze; a single specimen.

Considering the more highly developed state of the internal and external organs of these animals, it may possibly be most conformable to the truth to consider them as types of the species itself, but judging, on the contrary, from the deposits, they may properly be regarded as transitional forms, uniting the species with its variety, *hyalina*. They attain a considerable size, as much as 100 mm. or more, and differ mainly in the scarcity of deposits, which in most of the specimens seem to be confined only to the pedicels and tentacles. Only in one smaller individual, about 45 mm. long, scattered deposits are present in the body-wall itself, but they do not seem to attain a very high degree of development, excepting in the caudal portion of the body, where they are well developed. A closer examination will show that some of the deposits (Pl. V. fig. 1) resemble those known in *Cucumaria abyssorum*, but that others, especially those in the caudal portion, are of the same shape as those characteristic of *Cucumaria abyssorum*, var. *hyalina;* the more common forms, however, seem to be irregular × -shaped bodies with short ill-developed arms, and even simple rods with one end spinous and directed outwards. Even transitional forms between the rods and four-armed bodies are not rare. As a rule, it may be observed that the arms of the deposits are shorter and the deposits themselves more irregular than is the case in *Cucumaria abyssorum* and its variety *hyalina*. The deposits in the pedicels closely resemble those in the typical form itself. The rest of the individuals obtained from Station 299 are devoid of deposits in the body-wall; only in the neighbourhood of the pedicels and in the pedicels themselves have I found deposits of the same characteristic shape as those in the smaller specimen above described. It may be kept in mind that the larger individuals are devoid of deposits, while the smaller have such, a peculiarity which

seems to be common to several forms of the genus in question. The specimens dredged at Stations 295 and 298 are totally devoid of deposits, the calcareous substance having probably been dissolved.

The integument is thin, often transparent. The calcareous ring resembles that in *Cucumaria abyssorum*, but appears narrower. The Polian vesicle and madreporic canal are single. The muscular stomach is not very well developed. The reproductive organs as well as the respiratory-trees are more highly developed than in the species itself.

Cucumaria abyssorum, var. *hyalina*, nov. (Pl. IV. fig. 7).

Body subcylindrical or fusiform, slightly curved, more tapered posteriorly. Tentacles ten, of almost equal size. Anus surrounded by some small papillæ and more strongly developed, tooth-like deposits. Pedicels arranged in a double row along each ambulacrum, slightly more numerous on the ventral than on the dorsal surfaces. Integument thin, glassy, and very rough from scattered, rather large four-armed deposits, resembling those in *Cucumaria abyssorum*, but provided with a long, spinous, outwardly directed process. Pedicels strengthened by terminal plates and transverse supporting rods almost like those in the species just named. Colour, white, transparent. Length up to 30 mm.

Habitat.—Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom temperature, 34°·2; Diatom ooze; three specimens. Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; depth, 1375 fathoms; bottom temperature, 35°·5; Globigerina ooze; two specimens.

Though this variety bears the closest resemblance to *Cucumaria abyssorum*, it is easily distinguished by several obvious characters. The posterior extremity of the body is not so evidently tail-like. The pedicels are more numerous and the integument is transparent glassy, and much rougher with the outwardly directed processes of the deposits visible to the naked eye. The characteristic four-armed deposits (Pl. IV. fig. 7) are scattered and distinct from those in the above named species by the presence of a rather large and spinous, outwardly directed process, running out from the base of one of the arms or from the central part of the deposits itself. Often that arm, which carries the spinous process, is shorter than the rest. The ends of the arms are commonly pierced by one to four holes, seldom by more. In less developed deposits the ends of the arms are completely devoid of holes, simple or provided with some minute branches. The diameter of the deposits measures as much as 0·4 mm. It may, however, be remarked that even in *Cucumaria abyssorum* the deposits show a tendency to develop such outwardly directed spines. The pedicels are supported by terminal plates and transverse supporting rods almost like those in the above cited species. From scanty materials I cannot give any detailed description of the papillæ and

"teeth" round the anus; the former resemble small undeveloped pedicels, the latter have the shape of rather large perforated plates with the margin very uneven, spinous. Commonly the deposits in the anal portion of the body are more crowded.

Only a single madreporic canal and Polian vesicle are present. The calcareous ring seems to be of about the same conformation as that in *Cucumaria abyssorum*, though in a lower state of development. The retractors are very short, only 4 or 5 mm. long. A well-developed muscular stomach is present. The genital tubes are short, simple, and collected into two bundles, one at each side of the mesentery. The respiratory-trees have short, scattered branches, all over their length.

The two specimens brought home from Station 300 are slightly larger, about 40 mm. long; and the surface of their perisome is very rough, almost spinous, from the large outwardly directed spinous processes which are visible to the naked eye.

Cucumaria kerguelensis, n. sp. (Pl. XII. figs. 6, 7).

Body fusiform, more tapered posteriorly. Tentacles ten, two ventral considerably smaller. Anus with minute teeth. Dorsal surface with pedicels distributed without order all over its ambulacra and three interambulacra; only anteriorly and posteriorly an arrangement in rows is discernible. Ventral surface with close-lying pedicels arranged in a double row along each ambulacrum; its interambulacra are well marked, naked, excepting anteriorly and posteriorly, where some small pedicels are present, making the arrangement in rows there less distinct. The outer or rather upper series of the two lateral double rows of pedicels is, however, not very well marked out. Deposits—scattered minute ×-shaped bodies; and crowded, irregular, angular, rounded, oval or elongate, perforated plates, with uneven margin, numerous holes and more and less prominent knobs. The most highly developed plates almost resemble scales with their upper surface convex and knobbed. A whole series of developmental stages from simple ×-shaped deposits are to be found. Colour in alcohol, light yellowish-grey. Length, 75 mm.

Habitat.—Station 149B, January 17, 1874; lat. 49° 28′ S., long. 70° 30′ E.; off Royal Sound; depth, 25 fathoms; volcanic mud; six specimens.

The body seems often to be slightly curved, with the anus bent upwards and the dorsal surface shorter than the ventral. In the foremost part of the body the pedicels are collected in five groups, consequently a tendency to an arrangement in rows of the dorsal pedicels is here traceable. Even posteriorly it is not difficult to distinguish the five rows. But for the rest, the pedicels are equally scattered over the dorsal surface. All the pedicels do not appear to be of equal size, some being considerably smaller.

The calcareous ring is small, of the ordinary shape, and its posterior margin is undulated without processes; the radial pieces are notched anteriorly and have about the same height as the interradial, 2 mm. A single Polian vesicle and madreporic canal are present.

The retractor muscles are attached at about the middle of the body. The two bundles of the genital organs are composed of simple unbranched tubes. The respiratory trees are not very richly provided with branches.

The integument is thin, pliable, and smooth. The minute ×-shaped bodies are very scattered, and situated in the exterior layer of the perisoma; their arms are curved, directed outwards, and sometimes even bipartite at their ends. They measure as much as 0·06 mm. in diameter. The plates are closely disposed, and vary greatly in form and size. Thus, one may find a complete series of developmental stages from ×-shaped bodies with the arms simple or dichotomously branched, and small irregular plates with a few holes, up to large round oval or angular, thick, convex, scale-like plates with numerous holes and knobs. These larger plates are composed of several layers, with the upper surface convex, almost acquiring an aspect like that of the scales of a *Colochirus*. The largest plates measure as much as 0·6 mm. or more. In the ventral perisome, especially near the middle row of pedicels, the plates often seem to be elongate, narrow, with two or three longitudinal rows of holes. The pedicels are supported by numerous crowded irregular transverse rods or rod-like plates, with a few perforations, and their terminal plates are not very well developed. *Cucumaria parva* is doubtless very nearly related to this species, and having found nothing contrary in the description of Ludwig, excepting the largeness of the individuals and the anal armature, I was almost inclined to consider them to be identical.

Cucumaria insolens, n. sp. (Pl. IV. fig. 5).

Body subcylindrical, with the anal portion often slightly curved upwards. Tentacles ten, of almost equal size. Pedicels of two kinds: larger, completely retractile ones arranged in double rows along the three ventral ambulacra, and even distributed on or near the dorsal ambulacra; and considerably smaller (papillæ ?) present all over the dorsal surface as well as in the anterior and posterior parts of the ventral surface. The integument is thick and hard from the presence of three kinds of deposits arranged in several superposed layers. The exterior part of the integument is furnished with numerous small cruciform bodies with the arms curved and more or less branched (incomplete cups); beneath these there is a rich layer of large, elongate or oval, thick, knobbed, and perforated buttons with one end drawn out into a narrow spinous portion, which is directed obliquely outwards; interiorly densely crowded, small, rounded, more regular buttons with few holes and knobs are to be found. The pedicels, the larger as well as the smaller, are strengthened by terminal plates and strong, irregular, branched or unbranched slightly perforated rods. Colour in alcohol yellowish-grey, often darker and brownish on the back. Length up to 40 mm.

Habitat.—Simons Bay; depth, 10 to 20 fathoms; numerous individuals.

This form of *Cucumaria* is very remarkable, and seems to present a certain relation

to the genus *Colochirus*, as may be seen from the following description in which the differences are referred to. The oval aperture, when closed, does not present the five prominences characteristic of the genus just named, and the anus, though often slightly turned upwards, is devoid of teeth. The three double rows of ventral pedicels are very distinct, but no marked sole is obvious. Posteriorly, these rows decrease and become almost invisible in the anal portion, which is to be clearly observed in the few specimens which have this portion extended. Even the dorsal ambulacra are provided with pedicels of about the same size and appearance, but they seem to be more scattered and arranged in double rows which are not very distinct; when fully retracted, it is almost impossible to distinguish them from the surrounding smaller pedicels. Only in a very few specimens were they sufficiently extended to allow their position to be determined. Anteriorly, immediately behind the crown of tentacles, one may always clearly observe some pairs of pedicels in connection with each of the five ambulacra. The other kind of pedicel is much smaller, and ought probably to be referred to those ambulacral appendages which are called "papillæ"; they are scattered all over the dorsal surface, and even over the anterior and posterior portions of the ventral surface between the series of larger pedicels. I never saw them extended. Considering the presence of pedicels and papillæ and their arrangement, the resemblance of this species to *Colochirus inornatus* is obvious, though it may be distinguished from it by the dorsal rows of true pedicels. On the other hand it is undoubtedly nearly allied to Semper's *Cucumaria versicolor*.

The calcareous ring (Pl. IV. fig. 5, *a*) is of the usual form, composed of ten simple pieces, without processes posteriorly. A single Polian vesicle and madreporic canal are present. The reproductive organs are composed of numerous narrow, unbranched tubes, and their efferent duct is long and slender. The ampullæ of the pedicels and papillæ are visible from the interior. The retractors are attached at about the middle of the body.

The cruciform bodies (Pl. IV. fig. 5, *f*), which are present in the exterior layer of the perisoma, lie closely though not crowded, and their curved, simple, or more or less dichotomously branched arms are directed outwards; they have a diameter of about 0·05 mm. Beneath these deposits a layer of rather large oval, elongate or rounded, knobbed and perforated buttons are to be found; they have one end rounded, the other on the contrary narrowed, prolonged, and spinous (Pl. IV. figs. 5, *b* and 5, *c*). The prolonged spinous end is always directed outwards, and in the very contracted specimens I examined, the buttons were often standing on their edges and had a fusiform appearance. They reach a length of 0·3 mm. The third kind of deposit (Pl. IV. fig. 5, *d*) consists of small rounded buttons, forming a rich layer beneath the former; they have only a few holes and knobs, and their diameter is about 0·1 mm. A whole series of transitional forms (Pl. IV. fig. 5, *e*), combining the two extremes of buttons, seem to be present.

The larger as well as the smaller pedicels are strengthened by terminal plates, and

strongly constructed, curved or straight, branched or unbranched perforated rods (Pl. IV. fig. 5, *g*). The terminal plates of the larger pedicels are mostly of greater circumference, though commonly not very well developed.

Cucumaria multipes, n. sp. (Pl. IV. fig. 4).

Body cylindrical, without any elevations or processes. Pedicels very crowded, disposed in a double row along each ambulacrum, rather long and probably not retractile. Tentacles, calcareous ring and inner organs unknown. Deposits—numerous densely crowded tables with irregularly rounded or mostly elongate, fusiform disks supporting an irregular spire which usually seems to be composed of four rods. The pedicels supported by terminal plates and closely packed transverse tables with the disks narrow and rod-like. Colour in alcohol, light grey.

Habitat.—Yokohama; depth, 8 to 10 fathoms; only a fragmentary specimen. From the scanty materials the description cannot be but very incomplete. When looking at the exterior of the body, one is almost tempted to believe the pedicels to be disposed in more than two rows on each ambulacrum, but examining the body-wall from the interior, it becomes evident that only two rows of pedicels are present. The pedicels are very closely placed, and do not seem to be retractile. Among those species of *Cucumaria* which are characterised by double rows of locomotive organs, there is only one form, so far as I know, furnished with tables alone in the perisome, *Cucumaria populifera*, Stimpson; but to judge from the descriptions of these forms, the calcareous deposits may have a form different from that of the species here described.

The deposits present only a single form, viz., tables (Pl. IV. fig. 4) which are very closely disposed. Their disks are sometimes irregularly rounded or multangular, but by far their most common form is oval or elongate, fusiform, with one or both ends slightly drawn out; they are completely smooth, penetrated by a varying number of holes, and measure 0·32 mm. in length. The spire is not very regularly formed, and from its state of solution it is difficult to get an exact idea of its appearance. It reaches a considerable length, 0·1 mm., and is composed of from two to four rods, united by several transverse beams and terminating in some irregular spines or teeth. In most cases it is impossible to distinguish the rods, but the spire seems to be perforated by a few longitudinal series of holes, and terminates in several curved or branched tops. The smaller disks support a spire of about the same size, or larger than that in the larger tables. In some of the larger elongate tables the spire is reduced to a central bridge, sometimes with a central hole.

Even the pedicels are strengthened by very numerous tables, but here the disks are much narrower, rod-like, transverse in position, with fewer holes, of which four or more are situated in the slightly dilated middle of the disks; their spire is more irregular.

Besides tables, terminal plates are to be found. This species is doubtless allied to *Cucumaria longipeda* described by Semper and von Marenzeller, but it is in want of any pedicels in the ventral interambulacra.

Cucumaria serrata, n. sp. (Pl. IV. fig. 1).

Body elongate fusiform, more tapered posteriorly than anteriorly. Tentacles of almost equal or of unequal size. Pedicels arranged in a simple row along each ambulacrum, excepting anteriorly behind the tentacles, where two rows instead of one are visible. No ambulacral papillæ or processes present. The interambulacra naked. Calcareous ring in a lower state of development. Madreporic canal single. Two Polian vesicles. Calcareous deposits —very crowded, closely disposed knobbed and perforated plates with one end drawn out into a long, straight, or slightly curved, spinous, and perforated process. Surface of the integument rough, on account of the oblique outward direction of the spinous processes of the plates. Colour in alcohol, light greyish. Length about 35 or 40 mm.

Habitat.—Station 150, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom temperature, 35°·2; coarse gravel; several specimens.

In some individuals all the tentacles are equal, but they are not so always. Thus, I have seen a specimen with six tentacles much smaller than the remaining four, and in another individual two tentacles were slightly larger than the rest, &c. The pedicels of each ambulacrum are not crowded, but arranged in a simple zigzag row at some distance from one another; only anteriorly is a double row to be observed. The pedicels do not seem to be completely retractile. The perisome is very hard, though not thick, from the very numerous densely crowded and partly overlapping plates which fill it up. Behind the tentacles, however, it has but few deposits. The plates (Pl. IV. fig. 1) are of a very characteristic form, somewhat resembling those in Semper's *Cucumaria leonina* and Brandt's *Cucumaria miniata*. They are more or less elongate, and directed obliquely outwards, so that the inner end is rounded or obtuse, broad and more closely fenestrated; the holes decrease in number towards the other, narrow, highly prolonged handle-like end, which terminates in some spines giving to the surface of the animal a high degree of roughness. Moreover, the plates are provided with larger and smaller knobs, and their margin is uneven. The handles of the plates are often more or less obviously curved. Their length is about 0·27 mm. The pedicels are strengthened by terminal plates and numerous other deposits partly of the same shape as those in the body-wall itself, though more or less deformed, partly resembling simple perforated irregular smooth plates; no supporting rods are present. The tentacles have rather large perforated, smooth plates (Pl. IV. fig. 1*b*), as well as numerous smaller, curved, fenestrated ones; even here no rods are to be detected.

The calcareous ring is very rudimentary, and does not appear to the naked eye unless

by treatment with a solution of potash. It consists of five very small fragile radial pieces, held together by some very minute interradial fragments; each radial piece is deeply notched. Only a single madreporic canal, but two cylindrical, narrow Polian vesicles, about 20 mm. long, are present. The alimentary canal presents anteriorly a kind of muscular stomach with strong muscular walls. The retractors are attached at about the middle of the body or a little more posteriorly. The genital tubes are simple, and the efferent duct very long. The respiratory-trees are slender and very little ramified. Considering the great resemblances, I am much inclined to consider this species to be identical with Semper's *Cucumaria leonina*.

Cucumaria serrata, var. *intermedia*, nov. (Pl. III. fig. 6; Pl. IV. fig. 2).

Habitat.—Station 150, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom temperature, 35°·2; coarse gravel; several specimens. Station 151, February 7, 1874; lat. 52° 59′ 30″, long. 73° 33′ 30″ E.; off Heard Island; depth, 75 fathoms; volcanic mud; several specimens.

So far as I can find, the only difference existing between the typical form and its variety is seen in the deposits, which are much larger in the former, and have the handle much longer and narrower. In the variety, the deposits only attain a length of 0·16 mm., and their handle is short, broad, and spinous. The plates themselves are oval, elongate, or sometimes almost round, and the number of holes and knobs is very variable. Moreover, some small ×-shaped bodies and rounded plates, with a few perforations, are to be observed in the integument of both forms, but these represent only different stages in the development of the plates. Anteriorly, the perisome is almost destitute of deposits. The pedicels and tentacles are strengthened by deposits of about the same shape as those in the true specific form; thus no rods are present, but only rather large, smooth, perforated plates of varying forms (Pl. IV. fig. 2*b*). Instead of two Polian vesicles, I often find four.

The specimens from Station 151 are considerably larger, some of them measuring 65 mm. or more, and they differ from the former mainly by the presence of a greater number of pedicels, which in some specimens seem to form a double alternating row along each ambulacrum. The smaller individuals, on the contrary, like those from Station 150, have them arranged in simple zigzag rows, excepting, of course, anteriorly, where two rows are always present. But it is a well-known fact that the young forms always have fewer pedicels situated in a simple row, while the older forms possess double rows.

Cucumaria serrata, var. *marionensis*, nov. (Pl. IV. fig. 3).

Habitat.—Marion Islands, December 26, 1873; depth, 50 to 75 fathoms; numerous specimens. Station 148A, January 3, 1874; lat. 46° 53′ S., long. 51° 52′ E.; depth, 550 fathoms; hard ground, gravel and shells; a single small specimen.

No other differences between the present and the two former specimens are to be found, except the fact that the calcareous deposits are smaller, and have fewer holes, but they are often more closely knobbed; moreover, the handle is more minute. They measure 0·14 or 0·15 mm. in length. Among these deposits one may find smaller almost roundish knobbed plates with only a few (four or five) holes and no handle, or only a rudimentary one, recalling those in *Cucumaria lævigata*. In this respect it seems that the variety *intermedia* forms a transition between var. *marionensis* and the typical *cucumaria serrata*. One of the specimens dredged at Marion Islands measures about 55 mm.; that part of it which is fully extended has only a simple zigzag row of pedicels on each ambulacrum, while the more contracted parts of the body have the pedicels in double rows. The Polian vesicles and a single madreporic canal are present.

Genus *Ocnus*, Forbes, 1841.

Ocnus typicus, n. sp. (Pl. XIV. fig. 11; Pl. VI. fig. 10).

Body narrow, elongated, tapered towards each extremity. Pedicels in a simple row along each ambulacrum, rigid, not retractile. The interambulacra naked. The ventral ambulacra with about twenty, the dorsal with about fifteen pedicels. Deposits of three kinds—large, thick, rounded, or oval scales; small, irregular, knobbed buttons; and minute dichotomously branched bodies or rosettes. Length of the largest specimen about 40 mm.

Habitat.—Hong Kong, at a depth of 10 fathoms; two specimens.

The body of this typical *Ocnus* is very elongate, slightly more tapered posteriorly than anteriorly. In one specimen the body is rounded and fusiform, in the other pentangular. Both specimens are more or less strongly curved. No anal teeth are present. The tentacles are retracted. The pedicels are hard, directed straight out from the body, and seem not to be capable of retraction. They are distributed in five very distinct simple rows, arranged in straight lines only, as is common in several northern species. The perisome is very hard, leathery, and the scales do not imbricate, but are visible externally as rounded larger or smaller darker spots. The scales are round or ovate, thick in the middle, decreasing towards the margin; they are built up of a strong calcareous network, and the largest have a diameter of 0·8 mm. to 1 mm. The buttons (Pl. VI. fig. 10*a*), about 0·06 mm. in diameter, present themselves under very different forms, having very seldom a symmetrical appearance. They are mostly irregularly rounded or oval, with a few, four to six, perforations, and with the margin uneven from the often rather prominent knobs which are situated on it. One or two knobs are also to be found in the middle of the buttons. The rosettes (Pl. VI. fig. 10*b*) are very

minute, about 0·024 mm. in diameter, and irregularly formed. Towards the extremities of the pedicels the deposits are more asymmetrical and sometimes rod-like.

There is no doubt that this species is nearly allied to Semper's *Ocnus imbricatus*, and mainly differs from it by the possession of buttons, and by the fact that the scales do not imbricate. Both forms seem to be very typical representatives of the genus *Ocnus*, and are characterised by a hard, thick perisome containing scales, as well as other deposits, and by the arrangement of the pedicels in distinct simple rows.

Genus *Colochirus*, Troschel, 1846.

Colochirus spinosus (Quoy and Gaimard), 1833 (Pl. XIV. figs. 3, 4; Pl. VI. fig. 12).

Habitat.—Port Jackson (Australia); depth, 6 to 7 fathoms; fifteen to eighteen specimens.

The largest specimen attains a length of 80 mm. The body is oval or elongate, more tapered posteriorly than anteriorly. In most of the specimens the mouth, and especially the anus, are turned upwards, the body acquiring thus the appearance of an Acidian. The mouth is closed by five projections of the perisome, and the anus is surrounded by about five conical teeth, which in most cases are difficult to discover because they have their place within the anal aperture. The anal portion of the body is covered with imbricating scales, which decrease in size towards the aperture itself. Excepting a simple row of six to eight sharp, conical prominences along each side of the body, the surface of the animals is almost smooth, but presents numerous small pits from the completely retractile pedicels and "papillæ." The two ventral tentacles are much smaller than the remaining eight. A single madreporic canal and Polian vesicle are present. The ventral pieces of the calcareous ring are narrower than the rest.

The ambulacral appendages are very minute and retracted in all the specimens, so that it is almost impossible to decide whether two kinds are really present. They are scattered without order all over the body, but are a little more crowded on the ventral than on the dorsal surface; only along the odd ambulacrum is a double row of ambulacral appendages traceable. As far as I can find, the only difference existing between the dorsal and ventral appendages is that the latter possibly has the sucking-disk slightly larger, and the terminal plate very slightly more developed, but both of them are strengthened by supporting rods of about the same shape. Each of the conical prominences along the sides of the body is in possession of an ambulacral appendage.

The calcareous deposits have about the same appearance as those in *Colochirus inornatus*, to which the species in question bears the nearest resemblance. The rounded or oval reticulate thick scales never attain a greater size, the largest having a diameter of from 2 to 3 mm. The cups are knobbed (Pl. VI. fig. 12*a*), very

flat, and made up of a central ×-shaped rod with the arms connected so as to form a complete knobbed ring. In most cases a branched or unbranched rod, or an incomplete network covers the concave side of the cups. The cups are rounded or oval, with a diameter of about 0·08 mm. The buttons (Pl. VI. fig. 12*b*) are very solid, rounded or oval, with in most instances four holes and very large knobs; they are somewhat larger than the cups. A few buttons (Pl. VI. fig. 12*c*) are almost smooth without knobs. The supporting rods of the ambulacral appendages are usually perforated in each end and in the enlarged middle.

Colochirus inornatus, von Marenzeller, 1881 (Pl. VI. fig. 8).

Habitat.—Japan; depth, 8 to 50 fathoms; ten specimens.

All the specimens are highly contracted, with the tentacles retracted within the body, which presents a fusiform appearance. The mouth is closed by five valvular projections, and is in most of the individuals bent upwards. The perisome is rather hard and inflexible. The anal portion of the body is much more tapered and distinctly turned upwards. The anus is surrounded by five very minute teeth. The two ventral are much smaller than the eight remaining tentacles. All the ambulacral appendages, even the dorsal ones, are completely retractile, and distributed all over the body, whereby the surface of the latter acquires a punctated or finely pitted aspect. No dorsal processes or elevations of the body-wall, which are so characteristic of most of the representatives of the genus *Colochirus*, are visible. Only in one specimen does the dorsal surface show traces of some minute elevations.

The pedicels, which are marked out from the remaining minute ambulacral appendages or "papillæ" by a larger and more distinct sucking-disk, seem to be arranged in three longitudinal ventral series. Each series is broadest at its middle, and is there composed of about five pedicels in breadth, but it decreases towards the extremities, where the pedicels finally form a double row. Even the ventral narrow interambulacra are occupied by some scattered "papillæ" and pedicels, the three series being not quite distinctly marked. The "papillæ" are closely crowded all over the dorsal surface and over the anterior and posterior parts of the ventral surface, while they, on the contrary, are very thinly scattered on the middle of the ventral interambulacra.

The ventral surface is light, the dorsal, on the contrary, darker, with light spots at each papilla. A single madreporic canal and Polian vesicle are present. The three ventral pieces of the calcareous ring are considerably narrower than the rest. The ring is always devoid of any posterior processes. The retractor muscles are attached to the middle of the body.

The deposits present themselves under several different kinds. In the exterior layer of the perisome numerous irregular, reticulate, more or less complete, almost flat cups

(Pl. VI. fig. 8*a*) are to be found with the inner and outer surfaces knobbed or spinous. These cups are built up of an × -shaped central rod, with the branched arms partly connected so as to form a knobbed or spinous continuous rim, partly free and devoid of any complete rim, a condition which seems to be the most usual. The diameter of the cups measures 0·10 mm. With the exception of these cups, one finds in the perisome small, regularly formed, thick, robust buttons (Pl. VI. fig. 8*b*) with large, rounded knobs and usually four holes, and, moreover, other numerous more or less regular or symmetrical buttons of a more delicate conformation, and provided with a greater number of holes and knobs. A whole series of transitional forms between the two extremes of buttons are to be seen. The scales do not reach any more considerable size. The pedicels are strengthened by rather large, robust and broad, crowded, rod-like plates, and also by terminal plates and buttons. Even the "papillæ" are supported by plates. On treating a piece of the integument with a solution of potash, one finds here and there larger and smaller almost smooth perforated plates, but these are probably derived from the pedicels or processes. Any more obvious imbrication of the scales in the anal portion of the body is not to be observed.

Colochirus violaceus, n. sp. (Pl. XIII. figs. 1, 2; Pl. V. fig. 4).

Body cucumiform, equally rounded anteriorly and posteriorly. Tentacles ten (?), only six being left. Pedicels arranged in three distinct series along the ventral surface, each series composed of four to five rows. The series decrease in breadth towards the extremities of the body, where the pedicels are represented by "papillæ." The whole dorsal surface is covered with small scattered conical papillæ, those on the ambulacra being slightly larger than those on the interambulacra, which are minute. Even the ventral surface carries minute papillæ on its interambulacra. The oral opening is surrounded by five groups of rather large conical papillæ, each group being composed of two or three papillæ united at their bases. The anus is surrounded by five very large and rough calcareous teeth. The perisome is thick, leathery, and remarkable on account of its scarcity in deposits, which consist of small, very irregular, smooth plates usually perforated by one to four, seldom more, holes; among these deposits, small rod-like or × -shaped ones are to be found. Excepting terminal plates and a few perforated, transverse rods, no deposits occur in the pedicels. The papillæ are provided with a few perforated rods, and are entirely devoid of or possess only very small terminal plates; moreover, the larger papillæ seem to be strengthened by large irregularly reticulated plates composed of several layers. Colour in alcohol, light violet, here and there inclining to yellowish and bluish; the papillæ and anal teeth are lighter, the former mostly resembling white or yellowish spots. Length about 190 mm.

Habitat.—Station 203, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; depth, 20 fathoms; mud; a single specimen.

Though the animal in question differs greatly in several respects from the typical representatives of *Colochirus*, it cannot be referred to any other hitherto known genus. The pedicels are rather large, cylindrical and retractile, with a well-marked sucking-disk. The three longitudinal series, into which they are collected, are broadest near the middle of the body, where four, five, or even six pedicels are placed side by side. Anteriorly and posteriorly each series decreases and consists finally of a double row of "papillæ" which have taken the place of the pedicels. The papillæ are very small, with broad rounded base and pointed top; they are scattered over the dorsal ambulacra and interambulacra, those belonging to the ambulacra being slightly larger, 2 or 3 mm. long. Even the ventral interambulacra carry such papillæ, which are more closely placed towards the middle of the ventral surface, especially along the sides of the series of pedicels; when retracted, the ambulacral appendages or papillæ which have their place in the neighbourhood of these series almost resemble the true pedicels, but differ from them mainly by their smaller size. Only very few are extended, and these present a conical form. The groups of larger papillæ round the mouth are well marked, each group is composed of two or three papillæ united at their bases. The anal teeth are hard and rounded, measuring about 4 mm. in length and breadth.

The calcareous ring (Pl. V. fig. 4*a*) is very strongly constructed; and measures about 37 mm. in diameter; it is composed of ten pieces without any posterior prolongations. The madreporic canal is single, dorsal, and attached to the mesentery. The single Polian vesicle is very voluminous, and has a length of 50 mm. The retractors are slender, attached at about the first third of the body. The reproductive organ consists of two very thick bundles of simple, unbranched, narrow tubes, from 40 to 50 mm. long. The ampullæ of the pedicels and papillæ depend freely into the peritoneal cavity and have a considerable length, those belonging to the pedicels measuring 12 mm. The cloaca and the respiratory organs are well developed.

The most obvious characteristic of the species in question is to be found in the deposits, which, instead of filling up the perisome, making it hard and inflexible, are comparatively small and scattered. They present a very irregular aspect (Pl. V. fig. 4*b*), some being round, oval or elongate, and usually pierced by very few holes, others resembling rods or ×-shaped bodies. The more strongly developed oval deposits measure 0·09 or 0·1 mm. in length, and bear some resemblance to buttons. The pedicels contain, excepting terminal plates, very few perforated rod-like plates near their extremities (Pl. V. fig. 4*c*). The small papillæ are even strengthened by a few irregular rods and a very feebly developed terminal plate; sometimes they almost seem to be devoid of deposits. In the larger papillæ, which I have been able to examine, I have found larger irregular thick scales composed of several reticulate layers, and even, though more rarely, simple perforated plates. These scales have a diameter of 0·6 mm.

Colochirus challengeri, n. sp. (Pl. XIV. figs. 1, 2; Pl. VI. fig. 11).

Body elongate, quadrangular, tapered towards each extremity. Mouth closed by five valvular projections. Anus surrounded by several sharp teeth, and the anal portion of the body slightly turned upwards and provided with overlapping scales. The ventral tentacles considerably smaller than the rest. Body-wall hard, leathery, almost inflexible, and its surface covered with numerous small, rounded, white, hard, calcareous protuberances, which are more crowded on the ventral than on the dorsal surfaces. Each protuberance penetrated by a small retractile pedicel. These protuberances are very closely disposed even on the two dorsal angles, giving these the aspect of two longitudinal rough and hard ridges. Along the four angles of the body a simple row of larger, scattered prominences, perforated by the pedicels, is visible. No arrangement of the ventral pedicels in distinct rows. Deposits—larger and smaller, thick reticulate scales; numerous irregular knobbed buttons with as many as sixteen or more holes; and small flat knobbed cups made up of a central ×-shaped rod and a knobbed ring. Length about 150 mm. Colour in alcohol, dark brownish-grey, with lighter longitudinal bands along the ambulacra and with all the protuberances whitish.

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; coral mud; three specimens.

This very characteristic species is nearly allied to *Colochirus spinosus* and *Colochirus inornatus*, and forms together with them a remarkable exception to the general rule in having no distinct longitudinal rows of pedicels on the ventral surface. I cannot agree with Semper in referring them to the genus *Thyone*, but von Marenzeller is doubtless right in regarding them as more nearly related to *Colochirus* on account of their general habit, the conformation of the calcareous ring and of the calcareous deposits, &c.

In two of the specimens not only the anal but even the oral portions of the body are bent upwards. The ventral surface with its two interambulacra is almost flat, slightly convex or slightly hollowed; a ridge is distinguishable along its odd ambulacrum only anteriorly and posteriorly, and by reason of this the extremities of the body present a more or less distinct pentangular aspect, while the rest of the body is quadrangular, with the two dorsal angles very well marked. The oral as well as the anal portions of the body are scaled, while no overlapping scales are to be found on the rest of the body, which is covered by a great number of small, hard, rounded, whitish elevations or protuberances penetrated by the pedicels. Like *Colochirus spinosus* this species is marked out by series of larger conical calcareous points or processes, and these are to be observed not only along the ventral lateral ambulacra, but even on the dorsal angles. I counted as many as eight or nine such points. So far as I can find, no distinction of importance exists between the dorsal and ventral pedicels. Both are

provided with supporting rods and terminal plates, but possibly the latter are more developed in the ventral pedicels. The pedicels always run out from the above mentioned hard, whitish elevations or points, which are pierced by them.

Only a single madreporic canal and Polian vesicle are present. The three ventral pieces of the calcareous ring (Pl. VI. fig. 11*d*) are narrower than the rest, and the posterior margin of the ring is uneven on account of the presence of short prominences.

The perisome is very hard and thick from the occurrence of three kinds of deposits, which bear a great resemblance to those in *Colochirus spinosus* and *Colochirus inornatus*. The scales do not attain any great size, excepting in the extremities of the body, where they are rather large, broad, visible to the naked eye, and slightly cover one another at the edges. The buttons (Pl. VI. fig. 11*a*) are very numerous, and vary greatly in form, size, and general appearance, scarcely any two being alike. They are distinctly knobbed, and pierced by holes varying in number from three or four to sixteen or more. The largest buttons attain a diameter of 0·2 mm. or more. Sometimes the buttons are almost smooth without knobs. The cups (Pl. VI. fig. 11*b*) are very flat, and do not seem to be present in very great abundance. They are mostly built up after the same plan as those in *Colochirus inornatus* or *Colochirus spinosus*, with the inner surface bluntly knobbed and the outer provided with more pointed knobs or spines. Sometimes an incomplete network covers the concave part of the cups. Their largest diameter measures about 0·06 mm. The pedicels are strengthened by simple or branched, broader or narrower, perforated rods (Pl. VI. fig. 11*c*) and by a well-developed terminal plate.

Colochirus quadrangularis, Lesson, 1830 (Pl. XIV. figs. 7, 8; Pl. VI. fig. 7).

Habitat.—Station 203, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; depth, 20 fathoms; mud; one specimen.

So far as I can find, no satisfactory description has been given either of this species or of *Colochirus tuberculosus*, so that it is very difficult, if not impossible, to get a correct idea of their appearances and distinguishing characters. Notwithstanding this, I cannot hesitate to refer the animal brought home by the Challenger Expedition from the Philippine Islands to the species in question.

The body, which has a length of about 90 mm., is distinctly quadrangular, with a simple row of large conical processes along each angle. The number of processes in each row is from twelve to sixteen. Anteriorly and posteriorly the odd ventral ambulacrum is provided with two or three processes. The flat ventral sole-like surface is marked by three longitudinal series of retractile pedicels, each series being composed of five or six rows. The ventral narrow interambulacra are naked, as well as the three dorsal ones. The longest process has a length of about 12 mm. and a breadth at the base of about

6 mm. The mouth is closed by five processes or valves, which carry some smaller protuberances. The anus is slightly turned upwards, and situated much nearer the dorsal than the ventral surface; it is surrounded by five small conical teeth, alternating with five broader scales.

The perisome is hard and leathery from several kinds of deposits. The rounded or oval, thick, reticulate bodies, or, as I prefer to call them, scales, do not attain so large a size as in the preceding species, but are, on the contrary, rather small in comparison with the size of the animal. Semper seems to deny their presence. The spheres are often incomplete and of varying shape (Pl. VI. fig. 7*a*). In the external layer of the integument the "hemispheres" or cups are to be found (Pl. VI. fig. 7*b*); they very seldom present a regular appearance, hardly two being alike. In most cases they are very slightly concave, perforated by several holes, of which the four central are usually largest, and their rim is provided with spines, which are sometimes confined to one end of the flat oval plate-like cups. One or several spinous or smooth beams cross the cups on their concave side. These cups are much more finely constructed than the spheres. The pedicels are supported by terminal plates, numerous transverse perforated rods of varying shape (Pl. VI. fig. 7*c*), and perforated, irregular, flat, knobbed cups (Pl. VI. fig. 7*d*).

The three ventral pieces of the calcareous ring are considerably narrower than the rest. A single Polian vesicle is present. Numerous small madreporic canals, of which one is slightly larger and situated in the dorsal mesentery, also occur.

Colochirus cucumis, Semper, 1868 (Pl. XIV. figs. 9, 10; Pl. VI. fig. 9).

Habitat.—Station 203, October 31, 1874; lat. 11° 6′ N.; long. 123° 9′ E.; depth, 20 fathoms; mud; a single specimen.

The body is very distinctly quadrangular, excepting anteriorly and posteriorly, where it is pentangular, the odd ambulacrum being there more prominent so as to form a fifth angle. The two dorsal angles carry conical tubercles or processes of unequal size, some being very small, and arranged in an irregular zigzag row. Moreover, the three ventral ambulacra also carry such tubercles anteriorly and posteriorly. The dorsal interambulacra have but few tubercles. In the specimen I have seen, the mouth and anus are bent upwards, and the former is closed by the five characteristic triangular valves. No imbricating scales occur round the anus. The three double rows of pedicels are very distinct.

The deposits are of several different kinds—large rounded or oval reticulate thick scales; rounded or oval reticulate spheres, about 0·09 mm. in diameter (Pl. VI. fig. 9*a*); smaller, more delicately constructed spheres (Pl. VI. fig. 9*b*), about 0·04 mm. in diameter;

and small hemispheres (Pl. VI. fig. 9*c*) of about the same size as the smaller spheres, provided with spines round the rim and on the network which closes the openings of those half-spheres.

Colochirus australis, Ludwig, 1875 (Pl. XIV. figs. 5, 6 ; Pl. VI. fig. 6).

Habitat.—Port Jackson (Australia) ; 6 to 7 fathoms ; a single specimen.

Though the individual obtained during the Challenger Expedition deviates in some points from the types described by Ludwig, I do not hesitate to consider them as identical forms. The animal has a length of about 75 mm. Anteriorly and posteriorly the body is distinctly pentangular, but towards its middle the odd ambulacrum becomes less distinctly angular. The anal teeth are indistinct. The mouth is closed by the usual five valves. The colour is darkish brown, with five lighter longitudinal bands, of which the three corresponding to the ventral ambulacra are almost yellowish. The surface of the skin is rough, especially on the dorsum, where the scales are much larger.

The dorsal tubercles or processes are small and not very prominent, some of them being of minute size. They are to be found only on the ambulacra, where they form a double row anteriorly but are situated in a zigzag line towards the posterior extremity of the body. The pedicels are arranged in a distinct double row along each ventral ambulacrum. The base of each pedicel is surrounded by a crown of small prominent scales (Pl. VI. fig. 6*d*), and the dorsal tubercles seem also to be formed by such scales, in the middle of which the dorsal ambulacral appendages are situated.

The scales are much larger in the dorsal perisome, especially along the ambulacra, where they form longitudinal series. The largest scales have a diameter of about 4 mm. Besides these deposits, numerous more or less irregularly formed, knobbed buttons (Pl. VI. fig. 6*a*), and scattered reticulate hemispheres (Pl. VI. fig. 6*b*), are to be found. Among the larger buttons, several more finely constructed smaller ones are seen. The pedicels have perforated rods and terminal supporting plates. A single Polian vesicle and madreporic canal are present. The three ventral pieces of the calcareous ring are narrower than the rest.

Colochirus pygmæus, n. sp. (Pl. IV. fig. 9).

Body elongate, decreasing posteriorly into a narrower caudal portion, quadrangular or rather pentangular. Mouth closed by five projections or valves. Anal portion of the body without visible scales and teeth. Ventral surface with three distinct series of pedicels, each composed of a double row ; anteriorly and posteriorly the pedicels are converted into conical non-retractile processes of about the same size as the pedicels, but

arranged in simple or double alternating rows. The two dorsal ambulacra have conical, non-retractile processes in a zigzag row. The interambulacra naked. Deposits—small reticulate cups with very spinous rims; crowded symmetrically formed buttons, with as a rule four holes and about ten knobs; and larger scales resembling simple perforated plates with uneven surfaces. Colour in alcohol, brownish. Length about 25 mm.

Habitat.—Bahia, September 1873; depth, 7 to 20 fathoms; a single specimen.

The body of this small species is provided with sharp angles along the four ambulacra, and with a more obtuse angle along the odd ventral one. As noted in the diagnosis, the pedicels and processes are confined to the ambulacra, but, to judge from the only specimen I have seen, a tendency to spread over the odd dorsal interambulacrum may be observed, a few very minute processes being situated near its middle line.

There is no doubt that this species is nearly related to Ludwig's *Colochirus australis*, though it differs from it in several important characters. Thus, the scales in the perisome are especially distinct, those of *Colochirus australis* being much larger, thicker, and composed of several superposed layers, thus constituting true net-shaped scales, while the "scales" of *Colochirus pygmæus* (Pl. IV. fig. 9*a*), composed of a single layer, resemble common, simple perforated plates, and do not exceed 0·5 mm. in length. These scales or plates are not crowded, but very scattered; they are mostly of an elongated form, several times longer than broad, and have the surfaces uneven from the presence of low knobs or elevations. The buttons (Pl. IV. fig. 9*b*) have a diameter of 0·08 mm., but often much smaller ones may be found; they do not seem to vary greatly in general appearance. The cups (Pl. IV. fig. 9*c*, *d*), which lie most externally in the perisome, are very minute, 0·028 mm. in diameter, and deeply hollowed; their free rim is provided with numerous processes or spines. The entire cups are built up of a strong ×-shaped body with the arms curved, sometimes slightly branched. The pedicels and processes are supported by transverse, perforated rods, mostly with a third arm at the middle (Pl. IV. fig. 9*e*).

From want of materials, I could not examine the internal organisation.

Genus *Actinocucumis*, Ludwig, 1875.

Actinocucumis typica, Ludwig, 1875 (Pl. XII. figs. 4, 5).

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; coral mud; a single specimen.

There is nothing to add to the description of Ludwig, excepting that I find some minute papillæ even on the ventral surface in the anterior and especially in the posterior parts. The pedicels seem to be rather stiff. According to Ludwig, the species has been previously obtained from Amoy (China) and Bowen (Australia).

Subfamily GASTROPODA.

Genus *Psolus*, Oken, 1815.

Psolus disciformis, n. sp. (Pl. IX. fig. 6).

Body rounded, oval, depressed, with the anal portion slightly conical. Within the anal aperture five small tooth-like papillæ. Tentacles ten (?). The dorsal scales are numerous and imbricating, smaller round the margin of the dorsal surface and round the anal and oral apertures. Most of the scales carry one or two minute papillæ, visible to the naked eye, and apparently running out from a hole in the scale; these papillæ are always strengthened by rudimentary minute terminal plates. The oval sole provided with three double rows of pedicels, the pedicels of the lateral ambulacra being much more numerous and crowded than those of the middle ambulacrum. The sole is supported by regularly formed, smooth oval, roundish or even elongated disks with the margin slightly uneven, and with no holes or a few minute ones; moreover, the sole contains a few smaller ×-shaped bodies or larger concave cup-shaped plates with a few large holes and an uneven knobbed rim. Pedicels with well-developed terminal plates, and irregular, perforated, rod-like plates. Colour, white. Length of the largest specimen, 25 mm.

Habitat.—Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ W.; depth, 245 fathoms; bottom temperature, 46°·0; blue mud; two specimens.

In both of the specimens examined by me the anal portion of the body is more distinctly conical and prominent than the mouth. No oral or anal valves are present, but the scales seem to overlap each other in the neighbourhood of the two apertures more distinctly than on other parts of the body. The margin of the dorsal surface is formed by minute plates. The scales between the mouth and anus amount to about thirty or more. The scales themselves are roundish, and their diameter slightly exceeds 1 mm. The minute dorsal papillæ are remarkable in having a network resembling the rudimentary terminal plates of pedicels, and I am almost tempted to believe these "papillæ" to bear some relation to the ambulacral system. At both extremities of the sole the lateral double-rows of pedicels are in direct communication with one another. That which especially distinguishes this species from the forms hitherto known is the very peculiar discoidal smooth plates (Pl. IX. fig. 6*a*) present in the ventral sole, and which are far more numerous and crowded than the scattered ×- or cup-shaped plates (Pl. IX. fig. 6*b*); the diameter of these disks and plates measures about 0·14 mm.

Psolus murrayi, n. sp. (Pl. XV. figs. 5, 6; Pl. VI. fig. 4).

Body not depressed, elongate, cylindrical, with the posterior end tapered, caudiform. The elongated rectangular sole provided with three simple rows of pedicels, those in the

middle row fewer and more distant from one another. Tentacles ten (?). The dorsal scales seem not to imbricate, and are covered by a thick integument containing numerous more or less irregularly formed reticulate cups. The dorsal surface is not smooth but rough with numerous small warts, and the scales are not visible exteriorly. The sole is strengthened by large perforated plates and small irregular cups. Length, 28 mm.

Habitat.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom temperature, 37°·2; green sand; a single specimen.

The general shape of the body bears some resemblance to that of *Psolus phantopus*, its caudal portion being conical and the ventral sole elongated and rectangular. At first sight one is almost tempted to believe that the perisome is devoid of scales, but a closer examination reveals their presence, though they are covered by a thick warty integument, filled with minute very irregular, reticulate cups, which sometimes take the shape of spheres. The scales are irregularly rounded, and do not seem to imbricate one upon the other. No oral or anal valves are present. The warts, visible exteriorly, appear to be formed by a network of the same structure as that which composes the scales themselves. The three series of pedicels are each made up of a simple row, the lateral containing about eighteen, and the median about nine pedicels. The three rows seem not to be confluent at the extremities as is the case in most of the species of this genus. The perisome of the sole contains large irregular, smooth perforated plates (Pl. VI. fig. 4*a*), as well as cups (Pl. VI. fig. 4*b*) resembling those in the dorsal body-wall. The tentacles are retracted, but probably ten in number.

The determination of the various species of this very interesting genus is indeed a very difficult task. They seem to form a continuous chain of transitional forms combining the extremes, and further investigations will probably result in the union of several forms which are now considered to be distinct species. *Psolus murrayi*, however, must be looked upon as a characteristic form.

Psolus incertus, n. sp. (Pl. VIII. fig. 4; Pl. VI. fig. 5).

Body not depressed, elongate, cylindrical, with the anal portion short, conical. Pedicels only round the margin of the ventral sole, arranged in two rows. Tentacles ten (?). The scales small, very numerous, and overlapping; they have one, two, or three small pores. No oral or anal valves. The sole supported by small irregular plates perforated by a few holes. Length, 20 to 35 mm.

Habitat.—Station 150, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom temperature, 35°·2; coarse gravel. Station 151, February 7, 1874; off Heard Islands; lat. 52° 59′ 30″ S., long. 73° 33′.30″ E.; depth, 75 fathoms; volcanic mud. Station 149c, Royal Sound (Kerguelen), January 19, 1874; lat. 49° 32′ S., long. 70° E.; depth, 60 fathoms; volcanic mud. One specimen from each locality.

Bell has recently described a new species, *Psolus* (*Hypopsolus*) *ambulator*, which is distinguished by its scales being provided with pores, which are the orifices of small pits in the substance of the scales themselves. In the species examined by me, the pores evidently penetrate the scales (Pl. VI. fig. 5*a*, *x*). By a very careful examination, one finds these pores to be minute spots or rings scattered over the surface of the animal. Having had only three small individuals at my disposal, I have not been able to make any closer anatomical researches, although this would have been very desirable, in order to get an idea of the function of these pores. Possibly they are in connection with the ambulacral system. The tentacles are retracted and not visible externally. The outer row of pedicels is situated in the margin of the sole. The deposits of the sole are few, and present the form of small irregular plates with two to four holes (Pl. VI. fig. 5*b*); the larger specimens seem to be devoid of any deposits in the sole.

Psolus operculatus, Pourtalès, 1868.

Habitat.—Station 49, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; depth, 85 fathoms; bottom temperature, 35°·0; gravel, stones; numerous small specimens. Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom temperature, 37°·2; green sand; several specimens.

So far as I can see, the greatest similarity exists between the Challenger specimens and those described by Pourtalès. The largest specimens have a length of about 20 mm.; the smallest are 8 mm. long, thus being very young. The body is oval, rounded, or elongate, flattened, mostly decreasing in height posteriorly. The mouth is closed by five larger triangular valves, which often alternate with some smaller valves. The plates closing the anus are much less regularly arranged. In the smallest individuals the oral and anal scales are more irregular and inconstant. The scales are almost smooth in the larger forms, but finely granulated and comparatively larger in the young; they overlap a little. The largest scales measure 4 mm. in diameter, thus being rather large in comparison with the size of the animal. A double row of pedicels surrounds the thin, soft, transparent sole; those of the outer row being smaller and situated on the inner side of the margin. The deposits of the sole consist of closely crowded, more or less cup-shaped, concave plates, with as a rule four large perforations, and several rather long knobs, which occur especially on the uneven rim; moreover, numerous incompletely developed, ×-shaped deposits, with the arms dichotomously branched, are to be found among the former. Some of the plates are of a more solid structure than the rest.

The specimens brought home from Station 320 evidently form a transition between *Psolus operculatus* and *Psolus squamatus*; I cannot state that they belong either to the one or the other of these two species. The largest individuals are about 20 mm. long, the smallest 4 to 5 mm. The oral and anal scales are much more irregular than seems to be

the case in *Psolus operculatus*. The deposits of the sole are very densely crowded, being larger, more plate-like, and provided with more holes than in the forms dredged at Station 49. In some specimens a few pedicels may be found on the odd ambulacrum.

Psolus antarcticus, Philippi, 1857 (Pl. XV. figs. 3, 4; Pl. VI. fig. 1).

Habitat.—Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ W.; depth, 175 fathoms; blue mud; six specimens. Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom temperature, 37°·2; green sand; a single very small specimen.

Though this species is doubtless nearly allied to the northern forms, especially *Psolus squamatus*, it differs considerably in several important points, and a comparison of the Arctic and Antarctic representatives will clearly show that they are distinct. The six specimens I have had at my disposal were all collected near the west coast of Patagonia, not far from the Strait of Magellan, so there can be but little doubt that they really belong to the species described by Philippi.

The largest specimen has a length of 50 mm. The body-form is like that of *Psolus squamatus*. The mouth is closed by five very large triangular valves, the sides of which are almost equal. In the largest specimen, which I am about to describe, the length of the sides of these triangular scales is 9 mm.; their slightly curved bases, being distinctly marked, give rise to a circular or angular ring. In two of the specimens, however, some of the oral scales are parted in two, thus presenting a more irregular arrangement. In the same manner, the anal aperture is closed as a rule by five distinct though much smaller scales, which give rise to a smaller anal circle round their base. The scales are almost smooth or very finely granulated, and do not overlap each other so much as is the case in the Arctic forms, and those which lie close to the oral scales seem often to be of considerable size. Very minute scales surround the margin of the dorsal surface. Seven to nine scales occur between the oral and anal scales. In all the specimens I have seen the scales have a brownish colour, excepting round the free margin, where a broad brim of a light greyish colour occurs.

The flat ventral sole is constantly surrounded by only two rows of pedicels, the exterior of which is situated in the sharp margin itself and contains much smaller pedicels. Anteriorly, and sometimes posteriorly, the odd ambulacrum carries very few—two, three, or four—pedicels. The deposits in the sole (Pl. VI. fig. 1) consist of irregularly perforated plates, with in most cases numerous distinct knobs; very seldom a plate devoid of knobs is to be found. Sometimes the plates are slightly hollowed so as to take the shape of very flat cups.

I have been able to compare this species with equally large specimens of *Psolus fabricii* and *Psolus squamatus*. I never found in them the well-marked oral and anal

valves, these openings being surrounded by circles of numerous scales which seem to decrease towards the openings themselves, so that the number of scales between the mouth and the anus was greater. Only in very small specimens (about 15 mm.) of *Psolus squamatus* have I observed a more or less regular arrangement of larger oral and smaller anal valves, but I have never observed this in *Psolus fabricii*, though I have examined much smaller individuals of this species. Moreover, there is a great difference in the arrangement of the pedicels, when comparing specimens of about the same size. As has been pointed out, *Psolus antarcticus* has two rows of pedicels, while equally large specimens of *Psolus squamatus* (about 50 mm. long) always have three rows. Even the odd ambulacrum in the northern form seems to have more pedicels. The deposits in the sole of *Psolus squamatus* resemble those in the same region of *Psolus antarcticus*, but they often seem to be devoid of knobs or other processes.

The specimen brought home from Station 320 is very small, 13 mm. long, and has the oral and anal valves very regularly arranged. Its pedicels are disposed in two rows round the sole, which seems to be completely devoid of deposits. The scales are comparatively large, so that only four are situated between the oral and anal valves. The surface of the scales is nearly smooth. Having seen only a single specimen, I could not make any detailed examination, but it seems probable that it belongs to the species in question.

Psolus squamatus, Düben and Koren, 1844 (var. ?) (Pl. XV. figs. 1, 2; Pl. VI. fig. 2).

Habitat.—Station 307, January 4, 1876; lat. 49° 24′ 30″ S., long. 74° 23′ 30″ W.; depth, 140 fathoms; blue mud; two specimens. Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ W.; depth, 175 fathoms; blue mud; two specimens. Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ W.; depth, 245 fathoms; bottom temperature, 46°·0; blue mud; several specimens.

The four individuals brought home from Stations 307 and 308 are rather large, varying from 50 to 60 mm. in length. If not identical, they cannot be considered as anything more than varieties of the northern form. They even seem to combine this form with *Psolus antarcticus*. A double row of pedicels surrounds the sole, those in the outer row being situated on the inner side of the margin. Strangely enough, one of the specimens obtained at Station 307 possesses pedicels on the odd ambulacrum, and these form a simple row at the middle of the body but an alternating double row posteriorly and anteriorly. Considering the fact that the other specimens are in want of the middle row of pedicels, and having regard to the general appearance of the body, it is most probable that this peculiarity may be referred to an individual deviation. The scales bear small rounded granules which occur especially round the free margin; the oral aperture is closed by five larger triangular scales, alternating with and partly

covering five (or more) narrow, smaller tooth-shaped ones; the anal plates are smaller than the surrounding plates and irregularly disposed, no distinct valves being visible. The largest plates between the mouth and anus measure 5 mm. in diameter. The perforated plates of the sole (Pl. VI. fig. 2) are more or less irregularly formed, in one specimen being almost smooth, in another provided with distinct not very numerous knobs. So far as I can discover, this form must be very nearly related to *Psolus operculatus*, of which species, however, I have not had the opportunity of secing any types.

The specimens dredged at Station 311 are much smaller, the largest being 30 mm. long and the smallest 20 mm. The slightly elevated anal portion is devoid of valves, and often even at the mouth no larger scales are to be distinguished. The body is covered by a large number of scales. The granulation of the dorsal scales is very fine. The thin almost transparent sole has only few more or less incompletely developed × - or plate-like deposits. These specimens must be closely allied to Bell's *Psolus peronii*, but differ from it by the form of the deposits in the sole.

Psolus ephippifer, Wyville Thomson, 1876 (Pl. XV. figs. 7–11; Pl. VI. fig. 3).

Body oval or almost cylindrical, not very depressed, about as high as broad. The oral aperture closed by five large triangular valves, and a less regular valvular arrangement covering the anal opening, which in some specimens seems to lie on the top of a small elevation. A double row of pedicels surrounding the sole, those in the outer row situated on the inner side of the margin. Anteriorly and posteriorly the odd ambulacrum is provided with a few pedicels. The irregular scales do not overlap each other very much, excepting round the margin, where they are of minute size. In some specimens the scales are almost smooth, in others, on the contrary, distinctly granulated. In the female, the dorsal surface has a well-defined saddle-like elevation formed of large tesselated plates of somewhat irregular form and with the surface smoothly granulated. Deposits in the sole—numerous more or less crowded, reticulate, knobbed, cup-like plates. Length about 40 mm.

Habitat.—Station 151, February 7, 1874; off Heard Islands; lat. 52° 49′ 30″ S., long. 73° 33′ 30″ E.; depth, 75 fathoms; volcanic mud; about forty specimens. Station 150, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom temperature, 35°·2; coarse gravel; two specimens. Royal Sound, Kerguelen; depth, 20 to 60 fathoms; one specimen. Marion Islands; numerous specimens. Station 145A, December 27, 1873; lat. 46° 41′ S., long. 38° 10′ E.; depth, 310 fathoms; volcanic sand; one individual.

Sir Wyville Thomson has already published the supposition that this species is nearly related to or possibly a variety of *Psolus operculatus*, and, indeed, they seem to present a great resemblance. It is almost impossible to point out any difference of importance

between the respective males. Both of them have the characteristic oral and anal valves, and a double row of pedicels, the exterior of which is situated on the inner side of the margin. In these points the three species, *Psolus antarcticus*, *Psolus operculatus*, and *Psolus ephippifer* seem to agree and to be distinguishable from the northern forms *Psolus fabricii* and *Psolus squamatus*, which when fully developed have more rows of pedicels and are devoid of any valves.

No other species of *Psolus* exists, which presents such a marked difference between the males and females. The former have no marsupium in the dorsal body-wall, which is thick, leathery, with numerous irregularly formed imbedded scales; moreover, the scales are not of equal size, some of them in the middle of the back being considerably larger, and they seem to overlap each other but very slightly. The granulation is in these male specimens very fine. There also have been brought home from the same locality numerous specimens which have the scales more distinctly overlapping, of more equal size, and rough from the presence of granules; in some specimens the granules are so crowded that no scales are visible. The extremes look so very different that one may be tempted to regard them as distinct species. Among forty specimens dredged at Station 151, twenty-seven are males and the rest females.

The females are peculiar on account of their saddle-like elevation, which is well-defined in the middle of the back and formed of large tesselated scales with the surface smoothly granulated. These scales are not of the same simple conformation as the other scales, but they are supported by a central column raised up on an expanded irregular foot-like portion imbedded in the perisome (Pl. VI. fig. 3, *a*). Thus, each scale has the aspect of a card-table formed by two irregular parallel disks united by a central column. Consequently, when the disks are fitted together edge to edge, a cloister-like space is left between their supporting columns. In this space or marsupium the eggs are hatched. On removing some of the plates one finds young in their early stages enclosed within that cloister-like marsupium.

To judge from a young immature specimen, 17 mm. long, the lower part or foot of the scales, which constitutes the marsupium, is formed first, the column and the disk or upper part being developed later by a kind of budding; consequently, in young forms the marsupium does not form a closed space owing to the interstices between the disks or upper parts of the scales. As the animal grows larger, these interstices become smaller and smaller, so that finally the angular disks are accurately fitted to one another. I may be allowed to quote the following words from the description of Wyville Thomson:—"As the embryos increase in size, the marsupium projects more and more, and at length the joints between the plates begin to open, and finally they open sufficiently to allow the escape of the young. The young in one marsupium seem to be all nearly of the same age. In *Psolus ephippifer* the marsupium occupies the greater part of the dorsal surface, and its passages run close up to the edge of the mouth, so that the eggs pass into them at once from the

ovarial opening without exposure." In the specimens I examined the marsupium seems not to run so far forwards as is pointed out by Wyville Thomson. Owing to the want of the necessary material I could not find the genital pore, but I am tempted to believe that it is situated more anteriorly than Wyville Thomson supposes.

The "sole" is supported by more or less irregular perforated flat cups (Pl. VI. fig. 3, *b*) with more or less numerous obtuse spines. Very often the "cups" are undeveloped, resembling irregular, reticulate, knobbed or spinous plates. A single madreporic canal and Polian vesicle are present.

Among the numerous specimens from Marion Islands, not a single one is provided with a marsupium on the dorsal surface, though there are females as well as males to be found. They resemble the true *Psolus ephippifer* almost completely, and differ only, so far as I can find, by having a slightly more distinctly marked conical anal portion. However, the presence or absence of a marsupium in the females may possibly be of such importance as to justify their separation into two species, in which case the forms from Marion Islands probably may be referred to *Psolus operculatus*, Pourtalès.

Subfamily Sporadipoda.

Genus *Thyone*, Oken, 1815; Semper, 1868.

Thyone fusus, var. *papuensis*, nov. (Pl. VII. fig. 1).

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; coral mud; a single specimen.

Though it may appear very strange, it is nevertheless true that the form brought home from Torres Strait is closely allied to the northern *Thyone fusus;* indeed, so much is this the case that I cannot find out any difference of importance, although I have had at my disposal a vast collection of northern forms from the west coast of Sweden, and have had the best opportunity of making comparisons between them.

The specimen from Torres Strait measures 34 mm. in length; its pedicels are small and very numerous, and are distributed over the ambulacra as well as interambulacra. Traces of an arrangement of the pedicels in longitudinal series are recognizable not only along the ambulacra but even along the interambulacra. Like the northern form, the anus is armed with calcareous teeth. Even the calcareous ring (Pl. VII. fig. 1, *a*) does not deviate in general appearance from that of the northern type; only with regard to the size, some difference seems to exist. Thus, the length of the ring in the specimen brought home by the Challenger Expedition is about 16 mm., while in a specimen of the typical *Thyone fusus*, about 70 mm. long, it is only 14 mm. long. But in both forms the posterior long prolongations seem to be composed of several smaller parts.

The calcareous deposits of the perisoma itself (Pl. VII. fig. 1, *b*), as well as of the pedicels (Pl. VII. fig. 1, *c*), are of quite the same conformation. Nevertheless, a small difference seems to exist; as a rule, the disks of the tables of the typical form are perforated by four holes, though they often have more, while the disks in the Challenger specimen have as a rule four larger central and four more peripheral small holes.

Thyone pervicax, n. sp. (Pl. V. fig. 9; Pl. XII. fig. 3).

Body elongate, cylindrical, equally rounded at both extremities. Mouth closed by five prominences of the perisome, stellate. The two ventral tentacles considerably smaller than the rest. Anus without teeth. Body covered by small, conical, hard, close-lying papillæ, carrying the pedicels. No arrangement in rows visible. The body-wall very thick and hard from crowded deposits of three kinds—cups; knobbed buttons usually with four holes; and larger, rounded, mulberry-like, scale-like bodies. Pedicels strengthened by irregular perforated plates or rods and terminal plates; the dorsal pedicels more conical, and with the terminal plates more rudimentary. Colour in alcohol, brownish. Length, 60 or 65 mm.

Habitat.—Station, Bahia; depth, 7 to 20 fathoms; a single specimen.

This species (Pl. XII. fig. 3) is remarkable in possessing hard conical papillæ crowded all over the body, on the top of which the pedicels are situated, thus presenting some similarity to Studer's *Trachythyone*. The dorsal pedicels do not seem to be so well developed as the ventral, their sucking-disks being rounded and their terminal plates more rudimentary. The thickness of the perisome, the stellate mouth, and the three kinds of deposits point to a certain relation to the genus *Colochirus*.

The calcareous ring (Pl. V. fig. 9, *a*) is composed of ten simple pieces, the radial with a deep incision posteriorly as well as anteriorly, giving the aspect of short, posterior prolongations. The three ventral pieces are slightly smaller than the rest. A single Polian vesicle and madreporic canal are present. The retractors communicate with the longitudinal muscular bands at about the first fourth of the body. The reproductive organs are well developed, consisting of numerous slender, simple tubes. The respiratory-trees are nearly of the same length as the body itself.

The outermost layer of the perisome contains the cups (Pl. V. fig. 9, *b*), which are pierced by four holes, and have the spinous rim directed outwards; their diameter measures about 0·048 mm. The very numerous buttons (Pl. V. fig. 9, *c*) are oval, 0·12 mm. long, and usually distinguished by four holes and a smaller number of large knobs. The mulberries are scattered among the former, and have a diameter of about 0·4 mm.

There seems to be reason to refer this species to the genera *Cucumaria* and

Colochirus as well as to *Thyone*, in consequence of the shape of its calcareous ring and calcareous deposits.

Thyone recurvata, n. sp. (Pl. V. fig. 7; Pl. VIII. fig. 6).

Body fusiform, tapered posteriorly into a long narrower caudal portion, curved, with the extremities turned upwards. Tentacles ten (?), retracted. Pedicels numerous, distributed all over the body, more densely crowded on the ventral surface, hard, stiff and not retractile. Anus without teeth. Perisome hard, brittle from close-lying, large, irregular, smooth plates with numerous holes; the plates overlap each other more or less. The exterior layer of the perisome contains a quantity of small cups, made up of an × -shaped body with the arms curved and their ends united to a spinous rim. Pedicels strengthened by about the same kinds of deposits, though the plates are more deformed and rod-like towards the terminal plates. Colour in alcohol, light yellowish, whitish. Length about 55 mm.

Habitat.—Kerguelen Islands; depth, 10 to 100 fathoms; a single specimen.

The form of the body reminds one of that in *Thyone raphanus*, &c. The shorter dorsal surface and the posterior and anterior portions of the ventral surface have the pedicels about equally distributed, while those on the remaining middle part of the ventral surface are much more densely crowded. No arrangement of the pedicels in rows is discernible. The tentacles are small and completely retractile, consequently I have not been able to study their form and number; it seems as if some of them are considerably smaller than the others.

The calcareous ring is very small, only about 3 mm. in diameter, and its posterior undulating margin is devoid of any prolongations; it is composed of ten simple pieces. Three Polian vesicles and a single madreporic canal are present. The retractors are attached somewhat in front of the middle of the body, and some of them are remarkable by being bipartite or tripartite towards their posterior ends; moreover, the tripartite retractor is attached to three different longitudinal muscular bands, which doubtless is an abnormality. The reproductive organs consist of two small bundles of short simple tubes. The respiratory-trees are not very richly provided with short branches. The cups (Pl. V. fig. 7, *b*) have the ends of the curved arms of the × -shaped central rod either simple or bipartite, in which latter case not four but eight holes are present; they have a diameter of 0·056 mm. The plates (Pl. V. fig. 7, *a*) overlap each other and form a continuous layer under the cups; they measure 0·6 mm. in diameter, and are usually provided with many holes. They have a very irregular form.

The species doubtless represents the Antarctic form of *Thyone raphanus*, but differs from it mainly by the absence of anal teeth.

Genus *Thyonidium*, Düben and Koren, 1844.

Thyonidium cebuense, Semper (Pl. IX. fig. 4).

Habitat.—Station 201, October 26, 1874; lat. 7° 3′ N., long. 121° 48′ E.; depth, 82 fathoms; stones and gravel; one specimen.

This specimen, which is 11 mm. long, is ovate and of a light yellowish-brown colour. The pedicels are comparatively long and their sucking-disks well marked; they seem to be disposed in five longitudinal series, but from the contracted state of the animal the arrangement is not very clear. The specimens examined by Semper have an arrangement of the pedicels in rows which is distinct only in the posterior extremity of the body, but it must be kept in mind that the Challenger specimen is younger, and that young forms are often characterised by having the pedicels more distinctly arranged in rows. I only counted nineteen tentacles. A single Polian vesicle and madreporic canal are present. The five interradial pieces of the calcareous ring (Pl. IX. fig. 4, *a*) are simple; each of the radial, on the contrary, consists of a larger main-piece and two posterior prolongations, each composed of two or three joints. Semper seems to have found only one kind of tables; in the Challenger specimen, however, I have observed, in addition to the small tables, large ones scattered among the former. The small tables (Pl. IX. fig. 4, *b*, *c*, *d*) have a rounded disk with the margin undulated and regularly perforated by eight peripheral holes and a slightly larger central hole; the diameter of the disks measures 0·08 mm. The spire of these tables, when fully developed, consists of four rods and one transverse beam, and terminates in about eight small teeth. Often, however, the spire is more or less incompletely developed. The larger tables (Pl. IX. fig. 4, *e*) have the disk more irregular and the spire mostly devoid of teeth; the disk measures 0·16 mm. in diameter or more. The pedicels are strengthened by deformed tables which have the disks elongate and rod-like, and the spire more or less irregular; their shape will be best understood from the figures (Pl. IX. fig. 4, *f*).

Since some small differences exist, and since, moreover, Semper's description of the calcareous deposits is very unsatisfactory, I cannot be fully convinced of the identity of the Challenger specimen with those examined by Semper.

Thyonidium rugosum, n. sp. (Pl. V. fig. 5).

Body tapered posteriorly into a conical caudal portion. Tentacles eighteen, five small pairs alternating with three pairs of large tentacles and two unpaired large ones. The smaller tentacles several times smaller than the larger. Pedicels very closely crowded, and distributed over the ambulacra as well as the interambulacra; no arrange-

ment in rows visible, excepting in the conical caudal portion, which is characterised by five double rows of light brownish pedicels, corresponding to the ambulacra. Only the ends of the pedicels are retractile, while the rest is hard, very rough, and more or less conical in shape. Perisome thick, hard, leathery, and very rough from numerous closely disposed, more or less overlapping tables composed of a mostly elongate or irregular fusiform, perforated disk and a long conical spire made up of two rods united towards the pointed top. The spire is especially long in the pedicels. Length of the contracted specimen about 35 mm. Colour in alcohol, brown with light pedicels and tentacles.

Habitat.—Station 167A, June 27, 1874; Queen Charlotte Sound, near Long Island; lat. 41° 4′ S., long. 174° 19′ E.; depth, 10 fathoms; mud; a single complete, contracted specimen, and caudal portions of numerous other specimens.

The only complete specimen I have had at my disposal is rather contracted, so that the pedicels appear more crowded than they really may be. Only the caudal portion seems to be devoid of pedicels on the interambulacra. The pedicels decrease in size towards the posterior extremity of the body, and they are uncommonly rough from the long spires of the tables. The anal aperture is surrounded by some small cylindrical papillæ, strengthened by reticulate plates without spires. The tentacles are retracted, their true position being difficult to determine. In conformity with the general condition in the genus *Thyonidium*, the tentacles are unequal and arranged in pairs, five pairs being several times smaller than the eight remaining tentacles, which are distributed as three pairs and two odd tentacles. Thus, these species deviate from the typical forms with twenty tentacles by the circumstance that two of the tentacles are unpaired.

The calcareous ring (Pl. V. fig. 5, *a*) is characterised by having its ten pieces composed of numerous small parts; the radial pieces are prolonged posteriorly and measure 25 to 30 mm. in length. The figure will give an idea of its construction. I only found a single madreporic canal and Polian vesicle. In consequence of the contracted state, the retractors are short but very thick; they seem to be attached at about the middle of the body. The respiratory organs are well developed.

The tables present themselves under very variable sizes and shapes, some being small and having a somewhat rounded or angular disk, others being elongate or fusiform, with a varying number of holes (Pl. V. fig. 5, *b* and *c*). The largest tables have a length of 0·50 mm. or more. The outwardly directed spires attain their greatest length, 0·16 mm. or more, in the pedicels. The spire is formed by two rods, united towards the elongated conical top, and separated at the base by a hole. At the ends of the pedicels the disks become more irregular and rod-like (Pl. V. fig. 5, *d*). The terminal plates of the pedicels appear to be rather incompletely developed.

Thyonidium rugosum is certainly nearly allied to *Thyonidium japonicum*, von Marenzeller.

Genus *Orcula*, Troschel, 1846; Semper, 1868.

(?) *Orcula hypsipyrga*, von Marenzeller, 1881 (Pl. V. fig. 6).

Habitat.—Station 233A, May 19, 1875; lat. 34° 38′ N., long. 135° 1′ E. (Japan); depth, 50 fathoms; sand; a single individual.

The specimen obtained by the Challenger Expedition has a length of about 120 mm., thus being much larger than the specimen described by von Marenzeller. The posterior extremity of the body is much more tapered than the anterior, and is destitute of any teeth. The colour in alcohol, is reddish or yellowish, brownish-grey, with the sucking-disks of the pedicels white. The pedicels are scattered all over the ambulacra and interambulacra, and do not present any arrangement in rows; they are slightly more numerous on the ventral surface than on the dorsal. The perisome is thin and pliable, but its surface is rough from the outwardly directed spires of the tables. The tentacles are small and completely withdrawn into the body, and therefore I am not able exactly to state their number and position; I counted only about thirteen tentacles. The five radial pieces of the calcareous ring (Pl. V. fig. 6, *a*) consist of several smaller parts and are prolonged posteriorly into two long processes, the narrow ends of which are joined to the corresponding ends of the adjacent pieces, exactly as stated by von Marenzeller. The interradial pieces are simple, without posterior prolongations. The length of the radial pieces is about 17 mm. A single madreporic canal and Polian vesicle are present. The retractors communicate with the longitudinal muscular bands near the anterior extremity of the body. The reproductive organs are well developed, and their tubes are about 20 mm. long, and slightly branched. The respiratory organs attain nearly the length of the body itself, and their branches are short and not very numerous.

Excepting the well-developed terminal plates of the pedicels, the perisome contains only calcareous tables (Pl. V. fig. 6, *b*) consisting of a more or less irregularly rounded, or even angular disk, with about twenty holes in it, and a spire composed of four, seldom more, rods, which are several times transversely connected. The spire is more or less conical, terminating in a single point or in several spines; its length is about 0·14 mm.

To judge from the description of von Marenzeller, the tables in the type-specimen have more holes in the disk than is generally the case in those of the specimen brought home by the Challenger Expedition. No other difference seems to exist.

Genus *Phyllophorus*, Grube, 1840.

(?) *Phyllophorus incompertus*, n. sp. (Pl. V. fig. 8; Pl. VIII. fig. 5).

Body in contracted state ovate, about equally rounded at each extremity. Mouth closed by five prominences, each formed by three to six or more small papillæ with black retracted tops. Anus surrounded by very minute, almost inconspicuous

teeth. Pedicels distributed all over the body, slightly more crowded on the ventral surface. The ends of the pedicels black. Tentacles nineteen or twenty, unequal, completely retracted, and consequently their true position unknown. Perisome rather thick, leathery, flexible, with two kinds of deposits—in the exterior layer, tables with a very much reduced disk and a longer or shorter spire composed of two rods terminating in two or several points; and in the interior layer small, irregular, spinous × - or H-shaped bodies with one, two, or more holes. The tables are very often highly reduced, needle-like, with one end enlarged and pierced with a hole and with the opposite end pointed, or obtuse and spinous, or even bifurcate. Pedicels strengthened by well-developed terminal plates, and, besides, by some elongated, rod-like or fusiform perforated plates surrounding the terminal plate. Colour in alcohol, brown, lighter round the pedicels; ends of the pedicels black. Length of the largest specimen, 65 mm.

Habitat.—Port Jackson; depth, 6 to 7 fathoms; two specimens.

The tentacles being withdrawn inside the body in both specimens, I cannot distinguish their mutual position or decide whether they are arranged in one or two crowns. However, considering the great similarity of this species with Selenka's *Phyllophorus* (*Urodemas*) *perspicillum* in several important points, I propose to refer it to the genus in question. As far as I can see, no particular tentacles are less developed than the others, but larger and smaller alternate without order. The calcareous ring (Pl. V. fig. 8, *a*) is composed of ten simple pieces, each bifurcated posteriorly. Though the pieces are rather large, about 16 mm. long., they are flexible, spongy, and not firmly constructed. A strong membrane surrounds the ring exteriorly, communicating to it a cartilaginous appearance. Numerous madreporic canals and Polian vesicles surround the water-vascular ring. The retractors seem to be attached at about the middle of the body, and are united with the longitudinal muscular bands by a mesentery. The ampullæ of the pedicels are visible on the inside of the perisome. The genital tubes are short, thread-like, and slightly branched. The respiratory-trees are well developed. The different kinds of calcareous deposits (Pl. V. fig. 8, *b*) are figured, consequently no further description of them is necessary. The longest tables measure up to 0·12 mm. or more, and the × - or H-shaped spinous bodies (Pl. V. fig. 8, *c*) have a diameter of about 0·05 mm.

With regard to the deposits, the calcareous ring, the numerous madreporic canals and Polian vesicles, the species bears the nearest resemblance to Semper's *Cucumaria maculata*.

When comparing the above description with that of Selenka's *Phyllophorus perspicillum*, one finds an evident similarity in internal and external organisation, and, considering that the forms in question are obtained from the very same locality, there could not be any doubt about referring them to one and the same species, if Selenka's statement as to the shape of the deposits were not so different. Selenka does not mention anything about the tables and × - or H-shaped bodies, but he figures,

on the contrary, some spectacle-like rods, which bear the greatest resemblance to the deformed or undeveloped tables figured by me. Possibly the other deposits escaped the attention of Selenka, though it is not probable, considering that they are present in great number. The supposition that *Phyllophorus incompertus* is identical with Selenka's species is strengthened by the fact that in the State Museum of Stockholm one specimen from the same locality is preserved, which agrees with the above description.

SURVEY OF THE GENERA AND SPECIES, HITHERTO KNOWN, BELONGING TO THE DENDROCHIROTÆ.

Family III. DENDROCHIROTÆ.

Tentacles dendriform. Retractor muscles present. Mouth and anus at opposite poles of the body.

Subfamily 1. STICHOPODA.

Ambulacral appendages in the shape of pedicels alone, or pedicels together with papillæ, the latter often placed on larger or smaller processes; they are mostly arranged in rows, on the dorsal as well as the ventral ambulacra; interambulacra, with comparatively few exceptions, naked. Tentacles ten, rarely eighteen, twenty, or twenty-four. Calcareous ring of ten pieces, which usually are simple and devoid of prolongations posteriorly.

Genus 1. Cucumaria, Blainville, 1834.

Tentacles ten, rarely of equal size, two ventral commonly smaller. Ambulacral appendages almost without exception in the shape of pedicels forming one, two, or more rows along each ambulacrum. Seldom pedicels also on the interambulacra. Deposits highly variable, very seldom in the shape of reticulate scales.

A. Ambulacral Appendages—Pedicels alone.

I. Pedicels present only on the ambulacra.

1. *Pedicels, at least the ventral ones, arranged in more than two rows on each ambulacrum.*

Cucumaria godeffroyi, Semper, 1868.

Body acutely ovate. Pedicels in three to four rows in each ambulacrum, excepting at the extremities of the body, where only two rows are present. Deposits—irre-

gular plates with very uneven or spinous margins, with a few larger holes and with distinct spines on the exterior surface. Calcareous ring without posterior prolongations.

Habitat.—Iquique (Semper).

Cucumaria grubii, von Marenzeller, 1874. *Cladodactyla dicquemari*, Grube, 1840. *Cucumaria dicquemarii*, Sars, 1857.

Body fusiform. Pedicels of the ventral ambulacra in three to four rows, those of the dorsal ambulacra in two to three rows; towards the extremities of the body the pedicels form one or two zigzag rows. Deposits—numerous thick, oval or elliptic buttons with numerous conical knobs or spines and minute round holes; smaller scattered buttons with round knobs and no holes (=developmental stages); a very few minute rods or spicules (=undeveloped cups) in the exterior layer of the perisome.

Habitat.—Mediterranean Sea (Grube, Sars, v. Marenzeller, Ludwig).

Cucumaria maculata, Semper, 1868.

Body ovate. Ventral pedicels arranged in four to six rows in each ambulacrum, the dorsal ones in two to three rows. Radial pieces of the calcareous ring with two long posterior prolongations. Deposits—scattered massive tables with the small disk uneven or spinous in the margin and perforated with four central holes, and having the spire resembling a simple column with strong spines at the top. In the pedicels the spire of the tables becomes much longer and the disk deformed and reduced to a spherical network.

Habitat.—Bohol (Semper), Port Jackson (Bell).

Cucumaria crucifera, Semper, 1869.

Body swollen. Ventral pedicels in four to six rows in each ambulacrum; the dorsal ones in only two rows. Calcareous ring without posterior prolongations. Deposits—large buttons resembling those in the Aspidochirotæ; and cruciform more or less spinous bodies.

Habitat.—Aden (Semper).

According to the figures, given by Semper, minute incomplete rosettes may also be present in the integument.

Cucumaria glaberrima, Semper, 1869.

Body swollen. Ventral pedicels in six to eight rows in each ambulacrum; the dorsal ones in only two or three rows. Calcareous ring small and without posterior prolongations. Deposits—scattered thick disk-like plates with dentate margin and four small holes.

Habitat.—Aden (Semper), Berbera (Ludwig).

2. *Pedicels arranged in one or two rows on each ambulacrum.*

a. Deposits—roundish or oval buttons with a few perforations and often with large rounded knobs, besides minute reticulate cups.

Cucumaria quinquesemita, Selenka, 1867.

The cups are irregularly reticulate, with the spinous rim complete or incomplete. The oval buttons form a thick layer, are smooth and more or less swollen, always with four holes. Calcareous ring with slender posterior prolongations.

Habitat.—Mendocino in California and (?) Charleston (Selenka).

Cucumaria planci (*Cladodactyla*), Brandt, 1835; von Marenzeller, 1874. *Cucumis marinus*, Rondelet, 1555. *Echinus coriaceus ad os fimbriatus*, Plancus, 1760. *Holothuria pentacta*, Gmelin, 1788 (*partim*). *Holothuria doliolum*, Lamarck, 1816 (*partim*); Delle Chiaje, 1828. *Pentacta doliolum*, Jæger, 1833 (*partim*). *Cladodactyla doliolum*, Grube, 1840. *Cucumaria doliolum*, Sars, 1857; Selenka, 1867. (?) *Cucumaria cylindrica*, Semper, 1868.

Body cylindrical or slightly pentangular. The closely packed innumerable knobbed buttons are of unequal size, the larger having more holes and knobs than the smaller. The flat cups are numerous, minute, formed by three curved spokes and a rim with short processes. According to Selenka, three ventral pieces of the calcareous ring are united together.

Habitat.—West coast of France (Barrois), Arrabida (Greeff), Mediterranean Sea (Ludwig, Marion, v. Marenzeller, Sars, Grœffe, &c.) (?), Mauritius (Semper, Hoffmann).

Brady and Robertson (1871) described an animal, dredged in the Firth of Clyde, under the name of *Cucumaria pentactes*, which probably may be identical with this species or the next one, but unfortunately their description is too unsatisfactory to decide it. They do not mention anything about the "cups."

(Mus. Holm.) Two specimens dredged at Naples and one at Portoré, agreeing with the description of Sars, &c. The buttons often seem to have about eight holes and twelve to fifteen knobs, but they have not seldom fewer, or even more.

Cucumaria lactea (*Ocnus*), Forbes, 1841; Düben and Koren, 1844. *Holothuria badotriæ*, Dallyell, 1851.

Habitat.—British Islands (Hodge, Forbes, M'Intosh, Möbius and Bütschli, Leslie and Herdman); west coast of Norway at Bergen and Christiansund (Düben and Koren, Sars, Danielssen).

This species must be very nearly allied to the preceding one, differing from it mainly by the simple rows of pedicels.

(Mus. Holm.) Very numerous specimens from the west coast of Sweden and Norway.

Length of the largest individual, 35 mm. Pedicels in simple zigzag rows along the ambulacra. Two ventral tentacles smaller. Calcareous ring, like that in *Cucumaria hyndmanni* and *Cucumaria elongata*, devoid of posterior prolongations. Deposits—more or less regularly formed, knobbed, perforated buttons; and minute cups. The buttons are of a roundish form and unequal in size, in number of holes and knobs; commonly the rounded knobs are rather prominent. Some of the buttons are of considerable size, almost plate-like, with numerous holes and knobs. The cups are in want of a true rim, the ends of the dichotomously branched curved arms or spokes, which constitute the cups, being never, or only seldom, connected with each other. Pedicels supported by perforated rods of the shape figured by Düben and Koren. Colour, whitish.

b. Deposits—oval knobbed buttons with four holes and undulated margin; larger plate-like ones with at least one complete circlet of smaller holes round the four central ones, and with uneven or knobbed surfaces.

Cucumaria vicaria (Ocnus), Bell, 1883.

Pedicels in pairs, like the typical forms of this group of *Cucumaria*, but so irregular that they present a zigzag arrangement in each ambulacrum. Some of the deposits attain to a great size; the smaller are developmental stages of the larger. The pieces of the calcareous ring delicate, without posterior prolongations (?).

Habitat.—Antarctic Sea (Bell).

c. Deposits—slightly irregular, oval or oblong buttons, with a smaller number of holes, with knobs or spines, and with one end drawn out into a considerable spine or dentate perforated process.

Cucumaria leonina, Semper, 1868.

Body ovate. No anal teeth. The oblong buttons have, according to the figure given by Semper, about seven holes, two smaller of which are situated in the narrower dentate end. Even the knobs seem to be few, though about twice as many as the holes. Calcareous ring devoid of posterior prolongations (?).

Habitat.—Singapore (Semper).

Cucumaria miniata (*Cladodactyla*, subgenus *Polyclados*), Brandt, 1835; Selenka, 1867; Ludwig, 1881. *Pentacta miniata*, Stimpson, 1857. (?) *Cucumaria albida*, Selenka, 1867. *Cucumaria fallax*, Ludwig, 1875.

Body cylindrical. Anus surrounded by five small radially disposed plates or teeth. Calcareous ring not very well developed, without posterior prolongations (?). Deposits like those in *Cucumaria leonina*.

Habitat.—Alaska (Ludwig), Sitka (Brandt), California (Selenka).

Cucumaria echinata, von Marenzeller, 1881.

Body ovate. Radial pieces of the calcareous ring with two very short, obtuse prolongations. Buttons with rounded knobs, about eight holes, and with one end drawn out into a long, slightly outwardly-directed, simple spine.

Habitat.—Japan or China (v. Marenzeller).

d. Deposits in the shape of tables alone, or tables together with plates.

Cucumaria populifer (*Pentacta*), Stimpson, 1864. (?) *Cladodactyla* (*Holigoclados*) *albida*, Brandt, 1835. (?) *Cucumaria albida*, Ludwig, 1881.

Body thick, fusiform, "covered with minute, perforated polygonal plates, each plate having from twenty-five to forty holes, and being armed with a sharp umbo or spine at the centre of its outward surface."

Habitat.—Sitka (Brandt), Puget Sound (Stimpson).

These plates of Stimpson may probably be referred to tables, the central spine being a reduced spire. Calcareous ring unknown.

Cucumaria calcigera (*Pentacta*), Stimpson, 1854; Selenka, 1867; Duncan and Sladen, 1881. (?) *Cucumaria hyndmanni*, Forbes, 1852. *Cucumaria korenii*, Lütken, 1857.

In the middle of the curved, posteriorly-tapering body, the pedicels lie more closely crowded, so as to form four rows. Integument thin, but rough and rather hard from very closely crowded deposits forming two layers; those in the inner layer being more oblong and narrow plates, generally pierced with two or three rows of holes; those in the outer being tables, consisting of an irregularly rounded, oblong or stellate disk perforated with more or less approximated holes, from the centre of which an elevation rises made up of fine rods, and terminating in spines or teeth. Calcareous ring with long posterior prolongations.

Habitat.—Greenland (Lütken, Duncan and Sladen, Ludwig, Norman), Wellington Channel (Forbes), Labrador (Verrill), Massachusetts (Stimpson), Nova Zembla and Sea of Kara (Stuxberg).

(Mus. Holm.) A great number of specimens dredged at Nova Zembla and several localities off Greenland. The largest measures up to 120 mm. in length, the smallest about 6 mm. Body always curved and tapering posteriorly into a caudal portion, while the anterior extremity is more truncated. The disks of the tables seem to be comparatively large, and the spire is generally of a more irregular shape, in consequence of which it is difficult to get any information as to its true shape; sometimes the spire seems to be built up of only two rods and one transverse beam, but it is mostly composed of several rods, and terminates in several spines. The underlying irregularly shaped plates sometimes seem to bear one or a few minute knobs or elevations near their centre. In the

pedicels the tables commonly have an elongated disk supporting a more or less rudimentary spinous spire. No true supporting rods seem to be present in the pedicels.

Cucumaria citrea, Semper, 1868.

Body pentangular, with numerous pedicels along the angles. Deposits—plates and tables; the former small, rectangular, with a few holes, the two central of which are often larger; the latter consisting of a disk, mostly pierced with only four large holes, and a spire made up of two rods or legs, which are not connected by transverse beams. Each of the ten portions of the calcareous ring composed of numerous small pieces; the five radial portions with two slender posterior prolongations.

Habitat.—Bohol (Semper).

Semper does not mention anything about the arrangement of the pedicels in each ambulacrum, whether they form two or more rows, wherefore I am not sure whether this species belongs to this group of Cucumaria. Besides the two kinds of deposits mentioned above, Semper figures a small calcareous body resembling an undeveloped rosette.

e. Deposits—irregular spinous rods or spicules.

Cucumaria nigricans (*Cladodactyla, Polyclados*), Brandt, 1835; Selenka, 1867; Ludwig, 1881. *Pentacta nigricans*, Stimpson, 1857. (?) *Pentacta piperata*, Stimpson, 1864.

Body elongated, ovate. The calcareous rods only present in the bivium. Pedicels devoid of terminal plates. No calcareous ring.

Habitat.—Sitka (Brandt, Ludwig), (?) Puget Sound (Stimpson).

f. Deposits—reticulate spherical bodies, ellipses or cups alone or together with scales.

Cucumaria semperi, Bell, 1884.

Body pentangular. Deposits—spherical bodies alone, made up of a central four-armed spicule, an oval smooth rim, thus constituting four larger holes, and one beam crossing the bodies at the middle. Supporting rods of the pedicels resembling folding eye-glasses. Calcareous ring, as in *Cucumaria citrea*, composed of a number of pieces.

Habitat.—Port Denison and Torres Strait (Bell).

To judge from the figure drawn by Bell, the deposits may be like oval "cups," pierced with four holes, and with the opening crossed by a beam; but these "cups" are somewhat different from those common in several species of Cucumaria.

Cucumaria chronhjelmi, n. sp.

Body indistinctly pentangular. Pedicels numerous, cylindrical, long, forming apparently a double row along each ambulacrum; at the middle of the body they seem to be more crowded, there being three to four rows, but this is probably a result of the contracted state of the body. Tentacles ten, two ventral smaller. Anus with small teeth. Polian vesicle and madreporic canal single. Calcareous ring very fragile, the interradial pieces being conical, pointed anteriorly; the radial obtuse, furrowed anteriorly and terminating posteriorly in two very slender prolongations. Deposits crowded, of two kinds; in the external layer of the perisome small reticulated spheres or globular cups; in the internal layer numerous hollow fenestrated ellipses of different size and shape, some being of a more elongated form, others more rounded, globular, and some being several times larger than the rest; among the larger ellipses are found here and there rather large scale-like bodies, composed apparently of a network of several superposed layers. Undeveloped ellipses, consisting of a small oval concave plate with four holes, may also be found. The pedicels have, round the large terminal plate, some irregular perforated plates, and, besides, numerous elongated rods with four holes at the slightly enlarged middle and a row of holes along each arm; the middle of the rods usually carries a kind of low conical, rounded spire. Length of the largest specimen, 55 mm. Colour, whitish.

(Mus. Holm.) Some specimens dredged at Vancouver's Island.

Cucumaria glacialis, Ljungman, 1879. *Cucumaria minuta*, Stuxberg, 1878.

Pedicels in simple rows towards the extremities of the body. Deposits—large, thick, reticulate, roundish or angular scales; and small undeveloped cups consisting of a cruciform body with the ends of the curved arms provided with three processes.

Habitat.—Spitzbergen (Ljungman), Nova Zembla (Stuxberg).

(Mus. Holm.) Numerous type-specimens obtained at Spitzbergen and Nova Zembla. At the middle of the body the pedicels are placed in double alternating rows. The calcareous scales, visible to the naked eye, are more or less close together, and built up of several (two or three) superposed reticulate layers so as to constitute solid reticulate bodies. The cups, which are rather solid, are devoid of rim because of the four (seldom three or five) curved arms not being united at their free outwardly directed ends. Calcareous ring very slender, devoid of posterior prolongations. Polian vesicle and madreporic canal single. There seems to be reason for believing this species to be identical with Fabricii's *Ocnus minutus*.

h. Deposits—more or less irregular, simple, smooth, perforated plates, together with reticulate cups or spheres.

Cucumaria elongata, Düben and Koren, 1844; Sars, 1857. (?) *Holothuria pentactes*, Linné, 1767, and O. F. Müller, 1788–1789. *Cucumaria pentactes*, Forbes, 1841; v. Marenzeller, 1874; Ludwig, 1879. (?) *Hydra corallifera*, Gærtner, 1762. *Holothuria dicquemarii*, Cuvier, 1817. *Holothuria gærtneri*, Jæger, 1833. *Cucumaria fusiformis*, Forbes, 1841 (according to Norman, 1868). *Holothuria montaguii*, Fleming, 1828. (?) *Holothuria fusus*, Rathke, 1843.

Body more or less distinctly pentangular, slender, decreasing posteriorly into a long narrower caudal portion. Pedicels forming a double row only at the middle of the body; towards the extremities they form a simple zig-zag row. Body-wall hard from closely placed large, smooth, oblong, sometimes irregularly rounded, perforated plates with numerous holes. The cups are built up of four curved spokes and a spinous rim.

Habitat.—West coast of Scandinavia northwards to Christiansund (Düben and Koren, Danielssen, Möbius, Lütken, Sars, Ludwig), (?) White Sea (Jarzynsky), British Islands (Forbes, Pennant, Montagu, Alder, Hodge, Norman, M'Intosh, Leslie and Herdman, Möbius and Bütschli), Holland (Möbius and Bütschli), France (Fischer), North of Spain (Fischer), Mediterranean Sea (Sars, v. Marenzeller, Ludwig).

(Mus. Holm.) A great number of specimens from the west coast of Sweden and two specimens dredged at Bay of Muggia. Calcareous ring, like that in *Cucumaria hyndmanni*, devoid of posterior prolongations, but its posterior contour is distinctly undulated.

The "Porcupine" Expedition brought home one individual from Station 10, 1870, dredged at a depth of 81 fathoms.

Cucumaria tergestina, Sars, 1857.

Body fusiform, more or less pentangular, slightly curved and more tapered posteriorly. Pedicels conical, hard, not retractile, arranged in five double rows. Body-wall hard from numerous long and narrow, rectangular, perforated plates. The cups consist of four, seldom five, curved spokes and a spinous rim.

Habitat.—Mediterranean Sea (Sars, Marion, Ludwig, Greeff, &c.).

This species is nearly related to the preceding one, but differs mainly in the thicker body, in the stiff conical pedicels and their arrangement in double rows all along the ambulacra, and in the much narrower and longer plates, &c.

(Mus. Holm.) Two specimens obtained at the Bay of Muggia.

"Porcupine" Expedition.—One specimen dredged at Station 31, 1870, at a depth of 177 fathoms. The body of this individual is curved, much more tapered posteriorly, so as to form a kind of narrower caudal portion. The conical, stiff, non-retractile pedicels form an alternating double row along each ambulacrum. Colour, light greyish or yellowish-brown. Body-wall hard, inflexible, with

numerous deposits. The plates are much elongated, several times longer than broad, quite smooth, with numerous holes, which in some narrower plates almost form two longitudinal rows. Calcareous ring of usual form without posterior prolongations.

Cucumaria cucumis (*Holothuria*), Risso, 1826; Sars, 1857; von Marenzeller, 1874.
Cucumaria pentactes, Selenka, 1867.

Body almost like that in *Cucumaria elongata*. The plates are irregularly rounded or oval, several times smaller than those in *Cucumaria tergestina*, very seldom of a more elongated form; often two holes are larger than the rest. The numerous almost spherical, reticulate cups are of a more irregular shape, so that an arrangement of radial spokes becomes invisible or very indistinct. Calcareous ring of usual form without posterior prolongations.

Habitat.—Mediterranean Sea (Sars, v. Marenzeller, Heller, Ludwig, Greeff, &c.).

(Mus. Holm.) Two specimens dredged at Bay of Muggia. When comparing specimens of this species with equally large ones of *Cucumaria elongata*, it will be found that the caudal portion is not so narrow, and that the pedicels form a distinct double row all along each ambulacrum. Three kinds of deposits are present; comparatively small, irregularly rounded, smooth plates, commonly of a more undecided shape, with a smaller number of holes, two of which are often slightly larger; large elongated smooth plates with numerous holes, resembling those in *Cucumaria elongata;* and minute reticulate cups built up of an irregular network. Colour, blackish-brown with light pedicels. The species is doubtless very nearly allied to *Cucumaria elongata*, in which species I also found small roundish plates, though not in such great numbers.

Cucumaria improvisa, Ludwig, 1875.

Body indistinctly pentangular, tapered posteriorly. Integument thin. Deposits—closely placed, irregular, oblong, perforated plates; and small reticulate cups built up of about four curved spokes and a spinous rim. Calcareous ring devoid of posterior prolongations.

Habitat.—Algoa Bay (Ludwig).

Probably this form of Ludwig's is not a distinct species; it resembles in most respects *Cucumaria elongata*.

Cucumaria ignava, Ludwig, 1875.

Body indistinctly pentangular, posteriorly narrowed, anteriorly prolonged into five points. Integument hard, from numerous plates and reticulate spheres. Anus with small teeth. Calcareous ring devoid of posterior prolongations.

Habitat.—Gulf of St. Vincent (Ludwig).

Ludwig does not describe nor figure the calcareous plates, consequently their true shape remains unknown.

i. Deposits—irregularly formed, perforated simple plates alone, seldom together with small rosettes or rods; sometimes the plates are rod-like but with holes.

α. Calcareous ring well developed, with posterior prolongations.

Cucumaria africana, Semper, 1868.

Body nearly cylindrical. Radial pieces of the calcareous ring composed of a main part and two separate posterior prolongations. Deposits—large plates with short spines.

Habitat.—Querimba (Semper), Mauritius (Haacke, Ludwig).

β. Calcareous ring well developed, but devoid of posterior prolongations.[1]

Cucumaria hyndmanni (*Holothuria*), Thompson, 1840; Forbes, 1841; Düben and Koren, 1845; v. Marenzeller, 1874.

Body subcylindrical, slightly tapered posteriorly. Deposits—thick, nearly smooth perforated plates, all alike. Terminal plate of the pedicels incompletely developed or rudimentary; supporting rods pierced with one hole (or more) at the middle, and one at each end.

Habitat.—West coast of Scandinavia, south of the Arctic circle (Düben and Koren, Danielssen, Sars, Möbius, Storm, Ludwig), British Islands (Forbes, Norman, M'Intosh, Herdman, Thompson), Mediterranean Sea (Grube, v. Marenzeller, &c.).

(Mus. Holm.) Numerous specimens dredged off the west coast of Sweden. The crowded, perforated plates are of an irregularly rounded form, smooth, thick, solid, and swollen in appearance; among these are found some thinner and more finely constructed ones. Often the plates are slightly elongated or oval, with one end slightly narrower, bent obliquely outwards from the body of the animal, and rough from some minute spines or elevations. The numerous rods of the pedicels bear at the middle a short third arm, reminding one of a kind of spire. A single Polian vesicle and madreporic canal. Calcareous ring devoid of posterior prolongations.

"Porcupine" Expedition.—A few specimens dredged at Station 23, July 2, 1869, at a depth of 420 fathoms.

Cucumaria exigua, Ludwig, 1875.

Body cylindrical. Ventral pedicels more numerous than the dorsal. Deposits—large internal, and smaller external smooth perforated plates. Pedicels with rudimentary terminal plate, × -shaped bodies and large perforated supporting rods.

Habitat.—China Sea and Chili (Ludwig).

[1] In *Cucumaria frauenfeldi* and *Cucumaria kirchsbergii* the calcareous ring is unknown.

Cucumaria tenuis, Ludwig, 1875.

Body ovate. Interambulacra almost destitute of deposits. Ambulacra (including pedicels) with irregular spinous, perforated plates and spinous rods, the latter more frequent than the former; also terminal plates in the pedicels.

Habitat.—Celebes (Ludwig).

Cucumaria frauenfeldi, Ludwig, 1882. *Cucumaria*, n. sp., Semper, 1868.

According to Semper, this species is nearly related to *Cucumaria frondosa*. Deposits—rather numerous, in the shape of spectacles, viz., rods with a hole in each enlarged end.

Habitat.—Java (Semper), Cape of Good Hope (Ludwig).

The description is very incomplete.

Cucumaria kirchsbergii, Heller, 1868. *Ocnus* (?) (*Cucumaria*) *kirchsbergii*, von Marenzeller, 1874.

Body ovate. Deposits—numerous oblong plates with slightly uneven surface, with one end produced into a narrow dentate process and mostly with two rows of holes; also, according to von Marenzeller, small rosettes. Pedicels with terminal plates and supporting rods almost resembling those in *Cucumaria hyndmanni*, to which the species seems to bear the greatest resemblance.

Habitat.—Mediterranean Sea (Heller, von Marenzeller).

Cucumaria californica, Semper, 1868. (?) *Pentacta frondosa*, Ayres, 1855, and Stimpson, 1857.

Body ovate, like that in *Cucumaria frondosa*. Deposits—large smooth plates with a comparatively small number of holes. Pedicels devoid of terminal plates, but with a few three-armed, perforated supporting rods.

Habitat.—Mazatlan in California (Semper).

Semper says that one cannot distinguish this species from *Cucumaria frondosa* without the most careful anatomical examination, wherefore I am somewhat uncertain whether the dorsal interambulacra are naked or carry some scattered pedicels or whether the tentacles are equal, as in the species mentioned. Possibly the species is only a young form of *Cucumaria frondosa*.

γ. *Calcareous ring in a low stage of development.*

Cucumaria lævigata (*Pentactella*), Verrill, 1876; Studer, 1877 and 1879; Smith, 1879.

Tentacles nearly equal. Pedicels of the dorsal and ventral surfaces nearly equally large.

Habitat.—Kerguelen Islands (Verrill, Studer, &c.).

An Antarctic form of *Cucumaria frondosa*. Compare the above description.

Cucumaria crocea (*Holothuria*), Lesson, 1830; Selenka, 1867. *Pentacta crocea*, Jæger, 1833. *Cladodactyla* (*Polyclados*) *lessonii*, Brandt, 1835. *Cladodactyla crocea*, Wyville Thomson, 1877 and 1878.

Tentacles typical, two ventral smaller. Dorsal pedicels more numerous and several times smaller than the ventral.

Habitat.—Falkland Islands (Lesson, Thomson).

Allied to *Cucumaria frondosa*. Compare the above description.

Cucumaria japonica, Semper, 1868.

Calcareous ring almost absent, only traces of radial pieces being left. Deposits—irregular, perforated plates with fine knobs or spines; larger plates near the anal aperture.

Habitat.—Japan (Semper).

Even with regard to this species, the arrangement of the dorsal pedicels and the size of the tentacles are not fully clear. Semper states that it is closely allied to *Cucumaria frondosa*.

II. Pedicels present in the ambulacra, and also scattered all over the interambulacra or over some of them.

1. *Pedicels arranged in double rows along the five ambulacra; besides, scattered ones on the dorsal interambulacra, whereby the dorsal rows become more or less indistinct.*

Cucumaria frondosa (*Holothuria*), Gunnerus, 1767; Forbes, 1841; Duncan and Sladen, 1881. *Holothuria pentactes*, O. F. Müller, 1806. *Pentacta frondosa*, Jæger, 1833. *Cuvieria frondosa*, Blainville, 1834. (?) *Cladodactyla pentactes*, Brandt, 1835. (?) *Cucumaria fucicola*, Forbes, 1841. *Botryodactyla grandis*, Ayres, 1854 and 1873. *Botryodactyla affinis*, Ayres, 1854.

Body ovate. Tentacles nearly equal. A quadruple disposition of the pedicels in the middle of the ambulacra common in old individuals; a few pedicels scattered over the dorsal interambulacra. Deposits—irregular smooth simple perforated plates. Some specimens, especially the larger, are almost devoid of deposits, while others are more or less richly provided with plates. Generally the plates are more frequent in, or in the neighbourhood of the ambulacra. Calcareous ring not very well developed.

Habitat.—Greenland (Lütken, Norman, Duncan and Sladen, Ludwig, Stimpson, &c.), Spitzbergen (Lütken, Ljungman), Thousand Islands in the Arctic Sea (Heuglin), off Beeren Island (Danielssen and Koren), Iceland (Lütken, Ludwig), west coast of Scandinavia from Finmark to Kattegat (Düben and Koren, M'Andrew

and Barrett, Danielssen, Sars), White Sea (Jarzynsky), British Islands (Forbes, M'Intosh, Leslie and Herdman, Ludwig, Norman), north and east coasts of North America southwards to Cape Cod (Forbes, Duncan and Sladen, Verrill, Ayres, Stimpson, Ludwig, Lütken), east coast of North America south of Cape Cod at Florida Reef (Pourtalès), west coast of North America at Gulf of Georgia (Selenka), and California (Ayres).

(Mus. Holm.) A very great number of specimens in different stages of development, brought home from North America, Greenland, Iceland, Spitzberg, Norway.

In old individuals the dorsal pedicels, being spread out over the adjacent parts of the three interambulacra—sometimes over the whole odd interambulacrum—do not present any well-marked double rows as do the ventral pedicels. The irregularly formed plates with uneven or spinous margins seem, as a rule, to be rare in the old specimens, and usually I only found them in the pedicels or in their neighbourhood. Calcareous ring slender, pliable, spongy, and in a comparatively low stage of development, without posterior prolongations. In small individuals the pedicels are, on the contrary, very obviously confined to the ambulacra even on the dorsal surface, and only a very few scattered ones may be found on the dorsal interambulacra. Often in such small forms the plates are more common in the dorsal perisome, while they are rare or totally absent in the ventral. In very small specimens the dorsal pedicels are fewer and smaller than the ventral, and only placed on the ambulacra.

"Porcupine" Expedition.—Two specimens dredged at Station 13; lat. 40° 16′ N., long. 9° 37′ W.; depth, 220 fathoms.

Cucumaria frondosa, var. *mediterranea*, Semper, 1868.

Habitat.—(?) Mediterranean Sea (Semper).

Differs from the type in its madreporic tubercle being much larger and in having two Polian vesicles.

Cucumaria dubiosa, Semper, 1868.

Body cylindrical. Tentacles nearly equal. Deposits—large roundish knobbed buttons with a few (four) holes; and more elongated ones with slightly more knobs and holes, and with one end drawn out, dentate and perforate. Calcareous ring unknown.

Habitat.—Peru (Semper).

Cucumaria parva, Ludwig, 1875.

Body cylindrical, tapering posteriorly. Tentacles typical. Calcareous ring devoid of posterior prolongations. Deposits—large perforated (smooth?) plates and small ×-shaped bodies. Dorsal pedicels irregularly dispersed so that no rows are traceable.

Habitat.—Chili (Ludwig).

Cucumaria canescens, Semper, 1868.

Body elongated, slightly swollen at the middle. Radial pieces of the calcareous ring with two long posterior prolongations. Body-wall thick. Deposits—tables consisting of an elliptical disk with eight or nine ovate swellings round the margin, and with a strong central spire formed by two rods; opposite to the spire is a roundish knob. In the internal layer of the perisome a simple knob is substituted for the spire, the deposits thus presenting the appearance of buttons.

Habitat.—Bohol, Pandanon (Semper).

2. *Pedicels in two or three rows along each ambulacrum; also more or less closely scattered ones on the two ventral interambulacra, the arrangement in rows being there more or less indistinct.*

Cucumaria longipeda, Semper, 1868.

Body pentangular, tapering posteriorly and anteriorly. Pedicels very long, in two or three rows along each ambulacrum, and, besides, a few on the two ventral interambulacra. Deposits—tables consisting of a roundish perforated disk and a spire composed of four rods, and one transverse beam. Radial pieces of the calcareous ring composed of a main part and two narrow separate posterior prolongations, each made up of two joints.

Habitat.—Bohol, Pandanon (Semper).

Cucumaria conjungens, Semper, 1868.

Body cylindrical, rounded anteriorly, tapered posteriorly. Ventral pedicels numerous, irregularly dispersed over the ambulacra and interambulacra; dorsal pedicels only confined to the ambulacra, where they form two to three rows. Radial and interradial pieces of the calcareous ring composed of several smaller parts, the former with two long articulate posterior prolongations. Deposits—tables, resembling buttons, with an oval knobbed disk perforated by a few (four) holes, and with a very short spire with two points.

Habitat.—Mariveles, Bay of Manilla (Semper).

3. *Pedicels in a double row along the ambulacra, and also scattered ones on both dorsal and ventral interambulacra.*

Cucumaria köllikeri, Semper, 1868.

Body ascidiform. Tentacles of equal size. Interambulacral pedicels smaller than the ambulacral. Deposits—roundish knobbed buttons with a few holes; and more

elongated ones with one end drawn out, perforated and dentate. Calcareous ring devoid of posterior prolongations.

Habitat.—Mediterranean Sea (Semper and Ludwig).

The species bears the greatest resemblance to *Cucumaria dubiosa*, from which, however, it differs not only in the arrangement of the pedicels, but also in the absence of any muscular stomach.

Cucumaria salmini, Ludwig, 1875.

Body tapering posteriorly and anus dentate. Tentacles of not quite equal size. Dorsal interambulacral pedicels more abundant than the ventral. Deposits and calcareous ring like those in *Cucumaria köllikeri*.

Habitat.—Celebes (Ludwig).

This form and the preceding must be closely allied, and possibly represent varieties of one and the same species.

Cucumaria syracusana (*Cladodactyla*), Grube, 1840; Sars, 1857.

Body ovate, with the pedicels very small. Deposits—numerous thick round or oval buttons, with numerous round holes and roundish or conical knobs; numerous crowded smaller roundish buttons with a few holes and knobs; numerous minute incomplete cups, made up of three-, seldom four-armed spicules, with the ends of the curved arms parted in two or more branches. Calcareous ring unknown.

Habitat.—Mediterranean Sea (Grube, Sars, Heller, v. Marenzeller, Ludwig), Calabar, off the west coast of Africa (Ludwig).

(Mus. Holm.). One specimen, dredged at Cagliari, of a dark brownish colour, almost black or inclining to violet. Deposits fully agreeing with those described and figured by Sars. The large buttons are more scattered, of a rounded ovate form, very thick, with one end slightly narrower, and with numerous small holes and large knobs, the knobs being either conical or rounded, excepting at the narrower end of the buttons, where they are conical and pointed. The small buttons have generally four holes and a smaller number of large rounded knobs. Five small individuals, obtained from the same locality, differ somewhat from the typical ones, in that the large buttons are more irregularly plate-like, not so thick, and have often one end drawn out into a very distinct, narrow, spinous portion, thus reminding one of the deposits in *Cucumaria köllikeri*.

Cucumaria punctata, Ludwig, 1875.

Body cylindrical. The double rows of pedicels less distinct at the middle of the body in consequence of the numerous interambulacral pedicels. Deposits—knobbed buttons, and perforated cups, built up of four curved spokes and a spinous rim. Calcareous ring devoid of posterior prolongations.

Habitat.—Barbados (Ludwig).

Cucumaria nobilis, Ludwig, 1875.

Body swollen. Dorsal interambulacral pedicels more frequent than the ventral which are very rare. Deposits—tables, made up of a roundish, irregular, perforated disk, and a short spire composed of two to four rods. Calcareous ring devoid of posterior prolongations.

Habitat.—Off Norway (Ludwig).

Cucumaria vegæ, n. sp.

Body more or less obviously curved, tapering nearly equally towards each extremity. Tentacles ten, two ventral smaller. Anus with five teeth, made up of a calcareous network. Pedicels in a distinct double row on each of the ventral ambulacra and in a less distinct double row on the two dorsal; smaller pedicels are also to be found scattered over the five interambulacra of the larger specimen, while in the smaller individuals the ventral interambulacra seem to be almost naked. A single Polian vesicle and madreporic canal present. Calcareous ring very slender, devoid of posterior prolongations. Deposits more thinly scattered, of two kinds; smooth rods, typically with a hole in each slightly enlarged end, thus resembling spectacles, but often of a more irregular form, more or less curved, with several, often three, holes placed at each end; and here and there smooth plates with uneven, undulating margin, and pierced with a varying number of round holes. The surfaces of the plates and rods are not quite level, owing to some very low, nearly inconspicuous elevations. Pedicels with a very fragmentary terminal plate or none at all, but devoid of any other supporting rods than such as are found in the body-wall itself. Length of the largest specimen, 38 mm. Colour in alcohol; dorsal surface and the ends of the body dirty brown; ventral surface yellowish-grey. Possibly this species may be nearly allied to *Cucumaria nigricans*.

Habitat.—Behring Island (Mus. Holm.).

Cucumaria perspicua, Ludwig, 1875.

Body swollen. Pedicels much more numerous in the ventral ambulacra than in the dorsal, but, on the other hand, less numerous in the ventral interambulacra than in the dorsal. Excepting terminal plates in the pedicels, no deposits. Calcareous ring without posterior prolongations.

Habitat.—Off Norway (Ludwig).

B. Ambulacral Appendages—Pedicels and Conical Papillæ.

Cucumaria versicolor, Semper, 1868.

Body pentangular. Pedicels in five distinct series along the ambulacra, the narrow interambulacra being naked. Among the dorsal pedicels, conical ambulacral papillæ may be found. Radial pieces of the calcareous ring with two shorter

posterior prolongations. Deposits—tables with large irregularly perforated disks and a long central spire formed by two rods; and minute, irregular, dichotomously branched bodies or rosettes.

Habitat.—Bohol (Semper).

The following forms of Cucumaria are very unsatisfactorily known, a re-examination of them being necessary.

Cucumaria minuta (*Holothuria*), Fabricius, 1780; Blainville, 1834. *Pentacta minuta*, Jæger, 1833. *Dactylota minuta*, Brandt, 1835. (?) *Psolinus brevis*, Forbes, 1841; (?) Kowalevsky, 1867. *Ocnus ayresii*, Stimpson, 1853. *Ocnus minutus*, Semper, 1868.

Habitat.—Greenland (Fabricius, Lütken, Norman), north-east coast of North America, Grand Manan (Stimpson), British Islands, Faeröe Islands, and Shetland Islands (Lütken, Forbes, Norman), Spitzbergen (Danielssen and Koren), (?) Mediterranean Sea (Kowalevsky).

Pedicels placed in simple or zigzag rows along the ambulacra, six to ten in each row; according to Lutken, fifteen pedicels in each ventral series and only a few in the two dorsal rows. Judging from the descriptions of Lütken and Stimpson, I am inclined to believe this species to be more nearly related to *Cucumaria lactea* or *planci* than to *Cucumaria frondosa*.

Cucumaria assimilis, Düben and Koren, 1844. *Pentacta assimilis*, Verrill, 1873.

Habitat.—Christiansund in Norway (Düben and Koren), coast of New England (Verrill).

Apparently resembling *Cucumaria lactea* of Forbes, in all respects, excepting that its deposits seem to be less closely crowded, but, on the contrary, more regularly formed. It is doubtless not a distinct species.

Cucumaria pusilla (*Holothuria*), Sars, 1828.

Habitat.—Norway, at Bergen (Sars).

Probably synonymous with *Cucumaria lactea* or one of its nearer relatives.

Cucumaria brunnea (*Holothuria*), Thompson, 1840. *Ocnus brunneus*, Forbes, 1841.

Habitat.—British Islands (Forbes, Thompson, Herdman).

A very dubious species, which seems to deviate from *Cucumaria lactea* and *Cucumaria assimilis* only by its brown colour.

Cucumaria lefevrii, Barrois, 1882.

Habitat.—West coast of France (Barrois).

Though there seem to exist some small differences between this form and some of the preceding ones, it may, nevertheless, be a very dubious species. According to

the researches of Barrois, it must closely resemble *Cucumaria planci*, but is said to have the calcareous ring composed of eight pieces and the cups built up of four curved spokes. Selenka has already pointed out that the three ventral pieces of the calcareous ring are united in *Cucumaria planci*; the cups in the latter species seem, however, to be usually formed of only three spokes.

Cucumaria panamensis (*Pentacta*), Verrill, 1867–1871.

Habitat.—Panama (Verrill).

Belongs to that group of *Cucumaria* which has the pedicels in double rows along the ambulacra alone. Skin filled with very numerous, minute calcareous grains or plates, but Verrill does not explain more exactly the shape of these deposits.

Cucumaria decollata (*Holothuria*), Gray, 1848. *Cucumaria montagui*, Bell, 1883.

Habitat.—British Islands.

Cucumaria neillii (*Holothuria*), Fleming, 1828; Leslie and Herdman, 1881.

Habitat.—British Islands.

Cucumaria dissimilis (*Holothuria*), Fleming, 1828; Leslie and Herdman, 1881.

Habitat.—British Islands.

(?) *Cucumaria planciana* (*Pentacta*), Delle Chiaje, 1841.

Habitat.—Mediterranean Sea.

(?) *Cucumaria ventactes* (*Pentacta*), Delle Chiaje, 1841.

Habitat.—Mediterranean Sea.

(?) *Cucumaria cucumis* (*Pentacta*), Delle Chiaje, 1841.

Habitat.—Mediterranean Sea.

(?) *Cucumaria tetraquetra* (*Holothuria*), Delle Chiaje, 1828. *Pentacta tetraquetra*, Delle Chiaje, 1841.

Habitat.—Mediterranean Sea.

Cucumaria saxicola, Brady and Robertson, 1871.

Habitat.—British Islands. As to the deposits, allied to *Cucumaria elongata*.

(?) *Cucumaria pusillus* (*Psolinus*), Norman, 1864.

Habitat.—British Islands (Norman).

Cucumaria thomsoni, Hutton, 1879.

Habitat.—Stewart Island, New Zealand (Hutton).

(?) *Cucumaria turbinata* (*Labidodesmus*), Hutton, 1879.

Habitat.—Stewart Island, New Zealand (Hutton).

Pentacta kowalevskii, Jarzynsky, 1885.

Habitat.—White Sea (Jarzynsky).

Genus 2. Ocnus, Forbes, 1841.

Tentacles ten, two ventral smaller. Ambulacral appendages—pedicels forming a simple row along each of the ambulacra, or, at least, along the dorsal and lateral ventral ones. Interambulacra, with a single exception, naked. Calcareous ring composed of ten simple pieces. Body usually distinctly pentangular, narrow, and the body-wall typically hard from crowded reticulate calcareous scales, or from a network almost forming a hard shell.

It seems impossible, for the present, to draw a line of demarcation between the genera *Ocnus* and *Cucumaria*. In several forms referred to *Ocnus*, the pedicels do not form simple rows, but are arranged in more or less distinct zigzags, which are really nothing but alternating double rows. Considering that *Ocnus vicarius*, *minutus*, *lacteus*, *brunneus*, and *assimilis* do not present any other distinctions, they may, without hesitation, be referred to the genus *Cucumaria*, the more so as they present in their general appearance the true *Cucumaria*-type. On the other hand, Semper mentions in his beautiful monograph another distinction which seems to be of more value. Thus, those forms should be considered as true representatives of the genus *Ocnus*, which were characterised by the possession of calcareous scales in the perisome like those known in the genus *Psolus*. *Ocnus molpadioides*, *pygmæus*, and *imbricatus* illustrate such forms, and even Sluiter's *Ocnus javanicus* may be ranked with them, though Sluiter points out that no true scales are to be found. These four forms appear to have the pedicels in all or most of the ambulacra arranged in distinct simple rows. For my own part, I cannot suppress my doubts as to the validity of these generic characters, which may be artificial. Even true *Cucumariæ* are armed with scales, though such species are very rare.

A. Interambulacra naked.

Ocnus pygmæus, Semper, 1868.

Dorsal and lateral ventral ambulacra with a simple row, each composed of six to eight pedicels. Odd ambulacrum with a double row of about sixteen pedicels. Deposits—large scales; and perforated plane or slightly concave disks, often with four holes slightly larger than the rest. Calcareous ring of ten pieces, the radial with a long bifurcate prolongation posteriorly.

Habitat.—Bohol (Semper).

Ocnus imbricatus, Semper, 1868.

Each of the five ambulacra with a simple row of hard pedicels; each row containing twenty-four to twenty-six pedicels. Deposits—large, overlapping scales; and small rosette-shaped bodies. The ten pieces of the calcareous ring truncated, not prolonged, posteriorly.

Habitat.—Bohol (Semper).

Ocnus javanicus, Sluiter, 1880.

Each ambulacrum with a simple row of twenty to twenty-three hard, brittle pedicels. Deposits—reticulate spheres resembling those in *Colochirus;* and an almost continuous calcareous network making the perisome very hard. Calcareous ring of ten simple pieces, the radial with a bifurcate posterior prolongation.

Habitat.—Java (Sluiter and Ludwig).

Neither from the description nor from the figures, drawn by Sluiter, is it possible to get a true idea of the shape of the deposits. In the description Sluiter speaks of "spheres" like those in *Colochirus*, and in the explanation of plates he enumerates three kinds, viz., "buttons," "tables," and "calcareous network."

B. Interambulacra with pedicels at the middle of the body.

Ocnus molpadioides, Semper, 1868.

Pedicels of the ventral surface longer and more numerous than those of the dorsal. Deposits—rounded smaller, and angular larger scales. The radial pieces of the calcareous ring with a long bifurcate posterior prolongation.

Habitat.—China (Semper).

Genus 3. Echinocucumis, Sars, 1859 and 1861.

Tentacles ten, unequal, two lateral much larger than the four dorsal, which in their turn are slightly larger than the four ventral. Ambulacral appendages—pedicels, arranged in rows on the ambulacra. Interambulacra naked. Integument rough. Deposits—crowded, perforated plates with a long spire or spine (=tables).

Echinocucumis typica, Sars, 1859, 1861. *Eupyrgus hispidus*, M'Andrew and Barrett, 1857.

Pedicels in alternating double rows along the ambulacra; those on the two dorsal ambulacra are much rarer and totally disappear at the middle of the body. The tables formed by a large, thin, circular or oval disk, with the numerous small round holes slightly smaller near the more or less uneven margin, and arranged in rows; the long spire is conical, spinous, and excentric in position

and perforated with longitudinal rows of holes. Calcareous ring made up of ten simple pieces without posterior prolongations; the five ventral pieces larger.

Habitat.—Norway (Sars, Storm, Möbius and Bütschli), several localities in the North Atlantic Ocean near Norway (Danielssen and Koren), Arctic Sea north from Norway (Hoffmann), north of Scotland (Théel), Bay of Biscay (Norman), Florida Reef (Pourtalès).

(Mus. Holm.) Several specimens from Norway.

"Porcupine" Expedition.—One specimen from Station 15, June 16, 1869; lat. 54° 1′ N., long. 12° 14′ W.; depth, 422 fathoms.

Echinocucumis adversaria, Semper, 1868.

Pedicels long, in double rows on the posterior narrow caudal portion; on the rest of the body they are placed three to four in breadth in the ventral ambulacra but are more rare in the dorsal. Disks of the tables deeply incised in the margin, thus acquiring a stellate or angular appearance; consequently the holes are fewer and placed in a manner different from that in the preceding species; the spire consists of a simple, long, imperforate spine. Tentacles unknown. Calcareous ring absent.

Habitat.—Bohol, Pandanon (Semper).

(?) *Echinocucumis alba* (*Chirodota* (*?*)), Hutton, 1872 and 1879.

Habitat.—New Zealand (Hutton).

The species is quite unknown, and certainly does not belong to this genus.

Genus 4. Colochirus, Troschel, 1846.

Tentacles ten, two ventral smaller. Anterior extremity of the body usually with five valves. Ambulacral appendages of two kinds—pedicels and papillæ, the latter often situated on the top of warts or protuberances. Pedicels, confined to the ventral surface, are, with a few exceptions, placed on the three ambulacra, thus forming distinct longitudinal series. The most anterior and posterior portions of the ventral surface are devoid of pedicels, which here are exchanged for papillæ. Exceptionally, papillæ may also be found scattered over the ventral interambulacra. Papillæ strictly belonging to the dorsal surface, where they form rows along the ambulacra alone, or are irregularly distributed all over that surface. Calcareous ring of ten simple pieces, devoid of posterior prolongations, three ventral pieces often narrower. Deposits—larger or smaller reticulate scales, together with one or several kinds of small bodies.

A. Ambulacral appendages of the ventral surface distributed over the ambulacra, as well as interambulacra, an arrangment of them in rows not being indicated or very indistinctly. Dorsal papillæ scattered, not placed on warts or protuberances.

Colochirus spinosus (*Holothuria*), Quoy and Gaimard, 1833; Selenka, 1868; von Marenzeller, 1881. *Cladolabes spinosus*, Brandt, 1835. *Stolus firmus*, Selenka, 1867. *Ocnus spinosus*, Semper, 1868. *Thyone firma*, Semper, 1868. *Thyone spinosa*, Semper, 1868.

Body oval or elongated, not angulated, more tapering posteriorly, with oval and anal portions turned upwards. Dorsal papillæ minute, and, like the ventral pedicels, scattered irregularly. A row of hard conical points along each side of the ventral surface. Deposits—large, knobbed buttons, with four holes; slightly smaller flat, spinous cups made up of a ring and a central × -shaped rod; and reticulate thick scales. Perisome hard.

Habitat.—China (Selenka), Port Jackson (Quoy and Gaimard).

(Mus. Holm.) Three specimens from Australia.

Colochirus inornatus, von Marenzeller, 1881.

Body elongated or fusiform, not angulated. Dorsal papillæ minute, scattered. Ventral ambulacral appendages—small pedicels and papillæ of nearly equal size, the former disposed in irregular series along the three ambulacra, and, besides, scattered on the interambulacra, the latter mingled with the former in the interambulacra; the longitudinal series of pedicels being thus indistinct. Deposits—reticulate, very flat, spinous cups; knobbed buttons with four to six holes, or more; perforated plates; and not very large scales.

Habitat.—Japan or China (von Marenzeller).

B. Ventral pedicels in three distinct longitudinal series; ventral interambulacra naked. Dorsal papillæ situated on larger or smaller warts or conical processes.

I. Dorsal papillæ in rows on the ambulacra; dorsal interambulacra naked.

1. *Pedicels, four to eight rows in each ventral ambulacrum.*

Colochirus quadrangularis (*Holothuria*), Lesson, 1830; Selenka, 1868 (*partim*); Semper, 1868. *Colochirus coeruleus*, Semper, 1868.

Body quadrangular. Dorsal ambulacral appendages very large, placed along the four angles of the body; four to six rows of pedicels in each ventral ambulacrum. Deposits—scales; reticulate spheres and cups; and small plates with four larger and some smaller holes, and with spines on one end.

Habitat.—Bohol (Semper), (?) Africa and Australia (Semper), Sumatra and Macassar (Ludwig), Offack in Waigou Island (Lesson).

(Mus. Holm.) One individual, 150 mm. long, from Hong Kong. Colour, yellowish or greyish-white, with some traces of a violet or bluish tone here and there, indicating the true colour of the living animal. Body quadrangular, with the mouth bent upwards and closed by five ridges or protuberances provided with processes. Anus dorsal, surrounded by five distinct teeth. A simple or alternating row of rather large conical processes is placed on each of the four angles, each row or angle having from twelve to sixteen such processes. The processes reach 15 mm. in length. Pedicels five to seven in breadth in each ventral ambulacrum. Another specimen, 75 mm. long, obtained in the Gulf of Siam, has a brown colour and only three to four pedicels in breadth in each series. A third individual from Australia is peculiar in that the left dorsal interambulacrum carries three protuberances, and the odd interambulacrum one.

Colochirus jagorii, Semper, 1868.

Body quadrangular. Dorsal processes not very large, arranged in simple irregular rows along the ambulacra. Ventral pedicels, five to six rows in each series. Anus with five teeth. Deposits like those in the preceding species.

Habitat.—Singapore (Semper).

The species is unsatisfactorily known. Semper omits to tell whether processes with papillæ are present also on the sides of the body on the boundary between the dorsal and ventral surfaces. If it be so, the species may probably be identical with the preceding one.

Colochirus tristis, Ludwig, 1875.

Dorsal appendages—large tubercles with papillæ disposed in longitudinal rows. Pedicels of the odd ambulacrum about eight in breadth; those of the lateral ambulacra about six in breadth. Anus with five small teeth. Deposits—delicate spheres and cups; larger reticulate spheres; and scales which in the dorsal integument reach a diameter of 2 mm.

Habitat.—Zanzibar (Ludwig).

Body-form unknown. Even the arrangement of the tubercles, whether they belong to the two dorsal ambulacra alone, is not fully clear.

2. *Pedicels, one or two, seldom three, rows in each ventral ambulacrum.*

Colochirus minutus, Ludwig, 1875.

Body quadrangular. The two dorsal ambulacra with a few minute papillæ. Pedicels not very numerous, arranged in a double row along each of the three

ventral ambulacra. Anus with teeth. Deposits—reticulate spheres or cups; large scales.

Habitat.—Bowen (Ludwig).

(Mus. Holm.) Two specimens, 18 mm. long, from Bowen in Australia. Besides the large scales and the cups, I find in the perisome other bodies, which seem to resemble the "buttons" in *Colochirus australis*, and are probably developmental stages of scales. For the rest, the specimens fully agree with those described by Ludwig. It seems not incredible that *Colochirus minutus* is a younger form of *Colochirus australis*.

Colochirus australis, Ludwig, 1875.

Body quadrangular. The two dorsal ambulacra with one or two rows of papillæ. Two, seldom three, rows of pedicels in each of the ventral ambulacra. Anus with small teeth. Deposits—reticulate half spheres or cups; numerous knobbed buttons; large scales.

Habitat.—Bowen and Sydney (Ludwig), Port Molle and Port Jackson (Bell).

(Mus. Holm.) Two individuals from Port Jackson and one from Bowen. The largest, 70 mm. long. The papillæ, forming an alternating double row on the two dorsal ambulacra, pass out from a low hard knobbed wart. As usual in this genus, papillæ may also be found anteriorly and posteriorly on the three ventral ambulacra. Interambulacra naked. Those pedicels which form the outer row in the two lateral series seem either to issue from very low knobby warts or to be surrounded at the base by calcareous knobs. The larger and smaller scales do not imbricate, except at the posterior end of the body. The knobbed buttons, seldom of a more symmetrical form, often become developed into irregular spheres.

II. Dorsal papillæ scattered on the ambulacra as well as interambulacra.

Colochirus australis, var. *armatus*, von Marenzeller, 1881; Ludwig, 1883. *Colochirus armatus*, v. Marenzeller, 1881.

Habitat.—Japan (v. Marenzeller and Ludwig).

This variety differs mainly from the species itself in that even the dorsal interambulacra carry small warts with papillæ, and in that three to four rows of warts are present along the dorsal ambulacra. The scales are also smaller and the skin thinner.

Colochirus cylindricus, Semper, 1868.

Body cylindrical, slightly flattened below. Dorsal surface with crowded, larger and smaller tubercles with papillæ. Two to three rows of pedicels in each

ventral ambulacrum. Deposits—delicate, reticulate spheres; more strongly formed spheres; and scales.

Habitat.—Bohol (Semper).

Colochirus cucumis, Semper, 1868.

Body quadrangular. Each of the two dorsal ambulacra with a row of rather large papillæ; also a few, smaller scattered papillæ on the three upper interambulacra. Pedicels two in breadth in each ventral ambulacrum. Deposits—reticulate cups and spheres; scales.

Habitat.—Bohol (Semper).

(Mus. Holm.) One specimen dredged at Japan, 38 mm. long and 14 mm. broad, of a distinctly quadrangular appearance. Each of the three ventral ambulacra composed of two rows of pedicels; owing to contraction, three pedicels seem to be placed side by side in the middle of the lateral ventral ambulacra. The dorsal papillæ run out from lower or higher conical protuberances, the largest about 4 mm. long, forming a zigzag row along the two dorsal ambulacra. The sides of the body carry only a few smaller papillæ, and the space above the pedicels seems to be totally in want of them, or bears some very minute ones. Deposits—larger and smaller scales; reticulate spheres and other developmental stages of scales; small reticulate spheres and cups.

Colochirus peruanus, Semper, 1868.

Body *Ascidia*-shaped. Papillæ irregularly scattered over the back. Pedicels forming two rows along each ventral ambulacrum. Deposits—scales, and reticulate cups.

Habitat.—Peru (Semper).

Colochirus tuberculosus (*Holothuria*), Quoy and Gaimard, 1833; Semper, 1868. *Holothuria pentagona*, Quoy and Gaimard, 1833. *Stichopus tuberculatus*, Brandt, 1835. *Stichopus pentagonus*, Brandt, 1835. (?) *Colochirus quadrangularis*, Troschel, 1846. *Cercodemas anceps*, Selenka, 1867. *Cucumaria pentagona*, Semper, 1868. *Colochirus anceps*, Semper, 1868.

Body more or less elongatedly oval, not angular, or indistinctly so. Dorsal papillæ irregularly scattered, never attaining any considerable size. Pedicels forming four to six rows on each ambulacrum. Deposits—reticulate spheres or cups, and large irregular scales.

Habitat.—Tonga (Quoy and Gaimard), Port Jackson (Quoy and Gaimard), Port Molle, Port Denison, Torres Strait (Bell), Macassar (Ludwig), Malacca (Troschel), Singapore, Bohol (Semper), Hong Kong (Selenka, Semper), Amoy (Ludwig), Japan (Semper).

(Mus. Holm.) Two specimens, one from Australia, and the other from Guam, the

former 70 mm. long, the latter 163 mm. long. Body cylindrical or elongate, oval, nearly equally rounded at each extremity, neither quadrangular nor pentagonal, possibly slightly flattened on the sides and on the back. The closed mouth and the anus slightly bent upwards, the former surrounded by five not very large ridges, the latter with five distinct teeth. Five to six pedicels are placed side by side in each of the three ventral ambulacra, excepting towards the extremities of the body, where they decrease in number, and papillæ become substituted for them. The dorsal papillæ, more thinly scattered all over the back, are situated on the tops of low protuberances, those in the neighbourhood of the two dorsal ambulacra being slightly larger and more closely placed. Along the sides of the body, exteriorly to and above the lateral ventral ambulacra, there is a rather broad almost naked space. The thick perisome is filled with crowded deposits of several different kinds—large, irregularly rounded, thick, not overlapping scales; numerous crowded, delicately constructed reticulate spheres; scattered larger and more solid spheres, which seem to be transformed into scales; and numerous more or less irregularly formed, reticulate cups with spines round the uneven rim, these cups being present in the exterior layer of the perisome.

The following species of *Colochirus* are unsatisfactorily known, and require to be re-examined:—

Colochirus viridis, Semper, 1868.

Body cylindrical, flattened below. Dorsal ambulacra with two rows of conical papillæ. The odd ambulacrum with two rows of pedicels; the lateral ventral ambulacra with an inner simple row of pedicels and an exterior row made up of papillæ.

Habitat.—Samboanga (Semper).

Deposits unknown. According to the figure, drawn by Semper, the dorsal papillæ seem to be slightly irregular in position.

Colochirus colloradiatus, Haacke, 1880.

Pedicels sparingly distributed, forming one or two rows on each of the three ventral ambulacra. Papillæ very scattered, placed in a simple row along each of the two dorsal ambulacra. Deposits—scales in the dorsal perisome; two kinds of regularly formed bodies; and also irregularly formed bodies in different portions of the body.

Habitat.—Mauritius (Haacke).

Colochirus propinquus, Haacke, 1880.

Nearly allied to the preceding form, but distinct from it by the absence of regularly formed buttons.

Habitat.—Mauritius (Haacke).

Colochirus doliolum (*Actinia*), Pallas, 1766; von Marenzeller, 1874. *Holothuria doliolum*, Lamarck, 1816 (*partim*). *Pentactes doliolum*, Jæger, 1833 (*partim*). *Cladodactyla doliolum*, Brandt, 1835.

Habitat.—Cape of Good Hope (Pallas).

Genus 5. Actinocucumis, Ludwig, 1875.

Tentacles eighteen to twenty, unequal and irregularly disposed, two ventral being always smallest. Ambulacral appendages—pedicels and papillæ; the former arranged in several (four to six) rows along each ambulacrum; the latter, very small, scattered on the dorsal interambulacra and also among the pedicels on the dorsal ambulacra.

Actinocucumis typica, Ludwig, 1875.

Deposits—very numerous, small, perforated acorn-shaped bodies. Calcareous ring composed of ten simple pieces without posterior prolongations.

Habitat.—Bowen (Ludwig), Amoy (Ludwig).

Actinocucumis difficilis, Bell, 1884.

Habitat.—Albany Island, Torres Strait, Kurrachee (Bell).

Bell says:—"I have had the greatest difficulty in assuring myself of the specific distinctness of this form from the *Actinocucumis typica* of Ludwig." So far as I can judge, there exist no other differences between these two forms than in the shape of the deposits, these being in the species of Bell more simple, 8-like, with two holes and some knobs. Considering that even such deposits are not rare in the species of Ludwig, I am much inclined to refer them to one and the same species. Bell does not describe the calcareous ring.

Genus 6. Pseudocucumis, Ludwig, 1875.

Tentacles twenty, ten larger and ten smaller, alternating two and two; some of the smaller tentacles forming an inner crown. Ambulacral appendages in the shape of pedicels, arranged in rows along the ambulacra. Interambulacra naked. Calcareous ring composed of ten simple pieces without posterior prolongations.

Pseudocucumis acicula (*Cucumaria*), Semper, 1868; Ludwig, 1875; Schmeltz, 1879.

Ventral ambulacra with three or four rows of pedicels, dorsal with only one or two.

Deposits—peculiarly shaped needles, with holes at the obtusely rounded base.

Habitat.—Fiji Islands (Semper, Ludwig), Mauritius (Haacke, Ludwig), Ceram (Ludwig).

(Mus. Holm.) Eleven specimens of this very characteristic and easily recognised form; two dredged at Fiji Islands and nine at Tonga.

Genus 7. Amphicyclus, Bell, 1884.

Tentacles twenty-four, in two circles, those in the inner circle smaller, arranged in pairs, ten in number and radial in position; those of the outer fourteen, subequal. Calcareous ring and other deposits, excepting terminal plates in the pedicels and rods in the tentacles, absent. Ambulacral appendages in the shape of pedicels confined to the ambulacra and arranged in regular rows; in the dorsal ambulacra they are set in pairs, but are a little more irregular and crowded in the ventral. Interambulacra naked.

Amphicyclus japonicus, Bell, 1884.

Habitat.—Lat. 41° 12′ N., long. 140° 45′ E.; 43 fathoms; sand and mud (Bell).

A further examination will possibly shew such a close relation between this species and *Pseudocucumis acicula*, that they may be referred to the same genus.

Subfamily 2. Gastropoda.

Ambulacral appendages in the shape of pedicels alone, arranged in distinct rows on the flat, discoidal, sole-like, ventral surface. The convex dorsal surface naked, mostly covered with large scales. Tentacles ten, exceptionally fifteen, nearly equal. Calcareous ring of ten simple pieces, not prolonged posteriorly.

Genus 8. Psolus, Oken, 1815.

I. Tentacles ten.

A. Pedicels in three complete longitudinal series.

1. *Dorsal perisome devoid of large scales, only with minute plates or grains.*

Psolus regalis, Verrill, 1866; Bell, 1882. *Psolus granulatus*, Ayres, 1854.

Body like that of *Psolus phantapus*, though longer and narrower, and "its elongate-conical tail is much more nearly the result of a gradual tapering of the body" (according to Bell). The sole quadrangular. The lateral series of pedicels composed of about four rows; the odd series much narrower. Dorsal perisome

having a nearly uniform layer of innumerable minute, perforated plates, over which are scattered numerous round granules. Deposits of the sole like those in the dorsal surface, though less in quantity.

Habitat.—Banks of Newfoundland, George's Bank (Ayres).

According to Ayres the plates of the dorsal surface bear a strong resemblance to those in *Stereoderma unisemita*, being oval, smooth and usually pierced with four holes.

Psolus ornatus (*Lissothuria*), Verrill, 1867–1871.

Body elongated, depressed, with the flat lower surface broad. Anal region not very prominent. Pedicels numerous, forming six to eight rows in each longitudinal series. The soft dorsal perisome filled with minute grains, and fewer, somewhat larger, perforated ones. Round the naked part of the body below the tentacles, a ring of calcareous plates with pointed ends.

Habitat.—Panama (Verrill).

The species is unsatisfactorily known, and needs re-examination.

2. *Dorsal integument supported by large scales.*

Psolus phantapus (*Holothuria*), Strussenfeldt, 1765; Jæger, 1833. *Ascidia rustica*, Pennant, 1777. *Cuvieria phantapus*, Fleming, 1828; Düben and Koren, 1844. *Psolus lævigatus*, Ayres, 1854.

Body subcylindrical, *Ascidia*-shaped, with each extremity turned up; anal region elongatedly conical, caudiform. Sole rectangular. The lateral series of pedicels composed of two to three rows; the odd ambulacrum, at least in its middle, with only a simple row. The thick leathery dorsal integument with large granulated scales imbricating upon one another. The sole strengthened by reticulate cups and spheres.

Habitat.—West coast of Scandinavia from the Sound to Finmark (O. F. Müller, Danielssen and Koren, Lütken, Möbius and Bütschli, Sars, Düben and Koren, Möbius, &c.); Spitzbergen (Ljungman), Arctic Sea north from Norway (Hoffmann), Greenland (Lütken, Fabricius, Duncan and Sladen, &c.), White Sea (Jarzynsky), Iceland (Lütken), British Islands (Hodge, Dalyell, Lütken, M'Intosh, Forbes, Leslie and Herdman, Norman); east coast of North America, Banks of Newfoundland and Cape Cod (Ayres), Grand Manan (Stimpson), Chelsea Beach, Mass., Mount Desert, Eastport, Maine, Massachusetts (Verrill).

(Mus. Holm.) A great number of specimens from different localities of Scandinavia.

Psolus complanatus, Semper, 1868.

Body very much depressed. The lateral series of pedicels composed of four to six rows; the odd series, on the contrary, made up of two to three rows. The number of

scales across the whole breadth of the dorsal surface is fourteen to sixteen. Between mouth and anus ten to twelve larger and several smaller scales may be found. The scales slightly granulated. Deposits in the sole—rather symmetrical oval buttons with about four holes and rather large knobs round the uneven margin, and with a larger central knob; smaller, asymmetrical, knobbed, irregularly perforated bodies with the margin uneven and dentate.

Habitat.—Samboangan (Semper).

Psolus boholensis, var. *pandanensis*, Semper, 1868.

Body probably Ascidia-shaped. Lateral series of pedicels composed of two to three rows; the odd series composed of one or two rows. Number of scales across the dorsal surface, ten to twelve; between mouth and anus ten to twelve larger and several smaller scales are present. Deposits of the sole—asymmetrical plates with uneven margin, pierced with a few holes and provided with some small knobs; smaller asymmetrical plates with a few holes and dentate or spinous margin.

Habitat.—Bohol and Pandanon (Semper).

B. Pedicels on the two lateral ambulacra alone; odd ambulacrum naked or with an incomplete series of pedicels.

1. *Dorsal integument covered with scales.*

Psolus boholensis, Semper, 1868.

Body *Ascidia*-shaped, with the anal portion conical. Lateral series of pedicels composed of two to three rows; odd ambulacrum with an incomplete series of pedicels, its middle being naked. Dorsal surface with fifteen to sixteen scales across its breadth, and twelve to thirteen between mouth and anus. Deposits of the sole almost like those in the preceding variety.

Habitat.—Bohol (Semper).

Psolus fabricii (*Cuvieria*), Düben and Koren, 1844; Lütken, 1857; Kingsley, 1881; Ludwig, 1881; Bell, 1882. *Holothuria squamata*, Fabricius, 1780. (?) *Ascidia squamata*, Pallas, 1788. *Cuvieria sitchaensis*, Brandt, 1835. *Cuvieria squamata*, A. and E. C. Agassiz, 1865 (according to Verrill). *Lophothuria fabricii*, Verrill, 1866. *Psolus sitchaensis*, Semper, 1868.

Body depressed, *Chiton*-shaped, its periphery presenting an oval form. Lateral series of pedicels composed of two to five rows; anteriorly and posteriorly the odd ambulacrum carries some pedicels. Dorsal surface covered with large imbricating scales, with the free margin rounded and tightly covered with large granules,

which, however, in old specimens are not unfrequently abraded in places. Near the mouth and anus the scales are smaller and grouped around the openings, where a number of them are transformed into wart-like tubercles. The scales bordering the margin of the dorsal surface much smaller. The sole with reticulate cups or spheres.

Habitat.—Arctic Ocean, north from Norway (Danielssen and Koren, Hoffmann), north from Nova Zembla (v. Marenzeller), Greenland (Düben and Koren, Lütken, Normian, Duncan and Sladen, Ludwig), Newfoundland (Lütken), Grand Manan (Stimpson, Ludwig, Verrill), New England (Ayres), Massachusetts (Lütken, Bell, Gould, Verrill), Massachusetts Bay to Greenland (Verrill), Sitka (Brandt), Japanese Sea (Bell), (?) Kurile Islands (Pallas), (?) St. Paul in Bhering Sea (Middendorff). (Mus. Holm.) Numerous specimens from different localities of the Arctic Sea.

Psolus squamatus (*Cuvieria*), Düben and Koren, 1844; Koren, 1844; Sars, 1861; Bell, 1882. (?) *Holothuria squamata*, O. F. Müller, 1788. *Lophothuria squamata*, Verrill, 1873.

Body depressed, like that of the preceding species. Lateral series of pedicels composed of two to four rows. Odd ambulacrum always naked, though it possesses some pedicels in its anterior and posterior portions. Scales large, imbricating upon one another, with rather uneven margin, and covered with fine granules only. The sole, devoid of the cup-shaped bodies, is supported by more or less scattered, irregular, reticulate slightly spinous or knobbed plates.

Habitat.—West coast of Scandinavia from Bergen to Lofoten and Finmark (Sars Düben and Koren, Danielssen and Koren, Möbius and Bütschli, Barrett and M'Andrew), British Islands (Norman, Hodge), Gulf of St. Lawrence (Bell), coast of New England (Verrill).

The characters distinguishing the three last species appear to be very unimportant, and there may be a question whether they are distinct or not. However, *Psolus boholensis* has an *Ascidia*-shaped body, while the other two have it depressed, and the anal portion not prolonged into a conical tail. None of them have the large oral valves, peculiar to several of the following species.

Psolus peronii (subgenus *Lophothuria*), Bell, 1882.

Habitat.—(?)

Judging from the description of Bell, the general appearance of this species must be very like that of *Psolus squamatus*, and it is distinguished mainly by "a very large number of scales, only slightly imbricated near the margin," and by the possession of cup-shaped deposits in the ventral sole.

Psolus ephippifer, Wyville Thomson, 1877 and 1878.

Habitat.—Heard Islands (W. Thomson).

This Antarctic species is easily known from the Arctic forms, *Psolus fabricii* and

Psolus squamatus, by its small size and by having distinct oral and anal valves, and only two rows of pedicels around the sole. Its affinity with the two following species is much more apparent, and is such that it is almost impossible to draw a line of demarcation between them. Compare the above description.

Psolus operculatus (*Cuvieria*), Pourtalès, 1868, 1869. *Lepidopsolus* (*?*) *operculatus*, Verrill, 1867–1871.

Body oval, flattened, covered with finely and sparsely granulated scales, very compactly imbricated, but overlapping very little excepting near the mouth and anus. Oral aperture closed by five large triangular scales, alternating with and covering five narrow, tooth-shaped ones. Anus closed in the same way, but the scales are much less regular and constant. A double row of pedicels surrounds the soft sole, those of the outer row perforating the marginal plates; sometimes two or three pedicels are present anteriorly in the odd ambulacrum.

Habitat.—Sand Key and Florida Reefs (Pourtalès).

The species is doubtless nearly allied to *Psolus squamatus*, and appears to differ from it mainly in having larger, more regular oral valves, and in having only two rows of pedicels around the sole. Pourtalès does not describe the armature of the sole.

Psolus antarcticus (*Cuvieria*), Philippi, 1857; Semper, 1868; Studer, 1877; Bell, 1882. *Lepidopsolus* (*?*) *antarcticus*, Verrill, 1867–1871.

Habitat.—Strait of Magellan (Philippi, Studer), Portland Bay and Cove (Bell). According to Philippi, this species is nearly related to or identical with *Psolus squamatus*. Bell says that the body is much more flattened than in the last-mentioned form, and that the oral and anal valves are very much larger and more regularly arranged. Indeed, the oral valves consist of five large triangular scales, and the anal ones are also five but smaller. The scales covering the dorsal surface are large, so that only about five (Philippi) or ten to eleven (Studer) are placed between mouth and anus; they are also much less granulated or nearly smooth. Round the margin of the dorsal surface the scales are much smaller. Only a double row of pedicels is present round the sole. The deposits in the sole have not been described.

2. *Dorsal integument without scales* (*?*).

Psolus poriferus (*Cuvieria*), Studer, 1877 and 1879.

Dorsal surface furrowed, so as to present irregular poriferous spaces. Round the margin, however, poriferous scales seem to be present.

Habitat.—Royal Sound, Kerguelen (Studer).

The description given by Studer is very summary and unsatisfactory. The species is possibly identical with Bell's *Psolus ambulator*.

II. Tentacles fifteen.

Psolus cataphractus (*Stolinus*), Selenka, 1868; Bell, 1882. *Holothuria cuvieria*, Cuvier, 1817. (?) *Cuvieria cuvieria*, Jæger, 1833. (?) *Psolus cuvierius*, Semper, 1868.

Dorsal integument very smooth and stone-hard. Mouth and anus stellate, the latter not situated on a conical tail. Pedicels of the sole in three longitudinal series; round the sharp margin, which surrounds the sole, is a row of small pedicels without supporting terminal plates. Deposits—reticulate cups, which in the dorsal integument are more closely crowded and partly grown together so as to make it uncommonly hard.

Habitat.—Australia (Selenka).

Psolus ambulator (subgenus *Hypopsolus*), Bell, 1882.

Body like that in the preceding, without any tail. Each lateral ventral series of pedicels composed of five or six rows, and the odd series of about ten rows. The very large dorsal scales, which form about six not very regular rows of about four or five scales in each, are covered by a rather thick integument, and do not imbricate with one another. Five very large triangular scales surround the mouth; the five anal scales are particularly small. Many of the large scales have one, two, or rarely three small pores in their integument, which communicate with a small pit in the plate itself. Round the margin the scales are small and imbricating. Tentacles unknown.

Habitat.—Australia (Bell).

(Mus. Holm.) One specimen from Australia, which is certainly to be referred to this species of Bell; moreover, as will be seen from the following description, the general appearance and organisation of the species examined by me are much the same as those in Selenka's *Psolus cataphractus*; a resemblance in several important respects so striking that there is but little doubt they are identical. Thus, further investigations will certainly prove that *Psolus cataphractus* and *Psolus ambulator* are synonymous.

The specimen in question has the following measurements:—length of the sole 37 mm., breadth of the sole 12 mm.; height of the anterior part of the body 17 mm., height of the posterior part of the body 8 mm. Thus the animal does not attain more than half the size of that examined by Bell. Tentacles fifteen, somewhat unequal. Each lateral ambulacrum with three or four rows of pedicels; the unpaired ambulacrum with a broader series of pedicels. The five triangular oral valves are very considerable, while the anal valves are particularly small, giving to the anus an irregularly stellate aspect. The scales of the back are of various shapes, very large and thick, so that there are only four or five between the anus and the oral valves, and only about five across the back from brim to brim. The brim, or the lower part of the sides, forming the margin of the animal, is supported by a number of small scales. The whole back is covered by

a rather thick integument, containing numerous small, irregular, reticulate cups and spheres, the latter barrel-shaped, sparsely provided with bars, so that the meshes become large; the former made up of a much closer network with smaller, more irregular meshes, and with the spinous opening closed by spinous bars. The sole seems mostly to have cups or rather flattened hollow bodies made up of an irregular network, and with spines in the outwardly directed surface. Only a few of the large dorsal scales have distinct pores, which possibly are in communication with the ambulacral system (?), and, if it be so, we have an example in a *Psolus* with dorsal papillæ. The retractor muscles are united to the longitudinal muscular bands by a muscular membrane just as is described by Selenka in *Psolus cataphractus*.

The following two species are very incompletely described and impossible to identify:—

Psolus appendiculatus (*Holothuria*), Blainville, 1821; Jæger, 1833.

Habitat.—Mauritius (Blainville, Hoffman).

Psolus forbesii, Couch, Peach, 1845.

Habitat.—British Islands (Peach).

The great conformity in internal and external organisation makes it impossible, for the present, to point out any true characters distinguishing the greater part of the species of this genus. It represents a very interesting group of Holothurians on account of the numerous transitional forms which unite the extremes. One may question whether all the forms characterised by the possession of only two lateral series of pedicels are anything else than varieties of one species.

Subfamily 3. Sporadipoda.

Ambulacral appendages, almost without exception, in the shape of pedicels, scattered all over the body; seldom an arrangement of them in rows distinguishable. Tentacles ten to twenty. Calcareous ring of ten pieces, which are simple or compounded of smaller parts; the five radial pieces often prolonged and bifurcate posteriorly.

Genus 9. Thyone, Oken, 1815; Semper, 1868.

Tentacles ten, two ventral smaller. Pedicels more or less crowded all over the body; very seldom an arrangement of them in rows along the ambulacra discernible.

A. Anus with five calcareous teeth.

I. Calcareous ring composed of ten simple pieces, devoid of posterior prolongations.

Thyone suspecta, Ludwig, 1875.

Deposits very rare, but present in two forms—oval plates with uneven margin and about four holes; and cups likewise pierced with four holes and with the rim uneven. Pedicels with numerous supporting rods.

Habitat.—Barbados (Ludwig).

Ludwig supposes this species to be identical with *Thyone braziliensis* of Verrill, but if the statements of Verrill be right, it seems more credible that Ludwig's species is distinct, *Thyone braziliensis* being probably synonymous with *Thyone briareus*. Ludwig mentions twenty tentacles, which evidently is a misprint.

Thyone surinamensis, Semper, 1868.

Deposits—closely crowded, knobbed buttons; and scattered tables without disks. Anal teeth minute.

Habitat.—Surinam (Semper).

Thyone spectabilis, Ludwig, 1882.

Deposits—slightly curved rods with the ends perforated, branched, or spinose.

Habitat.—Strait of Magellan (Ludwig).

(Mus. Holm.) Numerous large specimens dredged during the "Eugenie" Expedition at Cape Virgins. This large *Thyone* is characteristic, agreeing in all respects with the description of Ludwig. Colour, yellowish-brown. Tentacles large, of equal size. Pedicels evidently more crowded on the ventral than dorsal surface, posteriorly more limited to the ambulacra. Calcareous ring rather solid, without any posterior prolongations. Polian vesicle and madreporic canal single. The smooth or slightly spinose rods are not very close together.

II. Calcareous ring composed of ten simple pieces, the radial with a bifurcate prolongation posteriorly.

1. *No deposits in the body-wall itself.*

Thyone briareus (*Holothuria*), Lesueur, 1824; Selenka, 1867. *Anaperus briareus*, Pourtalès, 1851. *Sclerodactyla briareus*, Ayres, 1854 and 1873. (?) *Thyone* (*Sclerodactyla*) *braziliensis*, Verrill, 1867–1871.

Deposits of the pedicels—terminal plates and tables with rod-like disk. Calcareous ring of ten simple pieces, firmly grown together; the radial with bifurcate prolongations posteriorly.

Habitat.—Several localities between Texas and Cape Cod, viz., East Florida (Pourtalès), West Florida (Verrill), Charleston (Selenka, Ludwig), North Carolina (Verrill), Sagharbor (Ayres), New Jersey (Lesueur, Pourtalès, Verrill), Connecticut, Long Island, Thimble Island, Vineyard Sound (Verrill), Fort Macon (Coues and Yarrow), (?) Brazil (Rathbun, Verrill).

(Mus. Holm.) Several specimens dredged at Wood's Hole, Massachusetts, and New York. The largest 100 mm. or more in length. Colour in alcohol almost black; pedicels brownish and their sucking-disks almost white. Anal teeth distinct. Pedicels very numerous and crowded. Deposits present only in the pedicels, consisting of terminal plates and a few tables, which have an elongated, fusiform, curved disk, with about four central holes and one or more at each slightly enlarged end; the spire seems to be made up of four rods. In one of the specimens examined by me, two Polian vesicles and a single madreporic canal were present. Calcareous ring rather large, with the sutures between the radial and interradial pieces visible, thus the ring does not form a continuous whole.

It appears somewhat doubtful whether *Thyone braziliensis* of Verrill is to be referred to this species, its pedicels being less numerous, its calcareous ring smaller, and, according to Verrill, not so distinctly provided with posterior bifurcate prolongations.

Thyone venusta, Selenka, 1868.

Pedicels with terminal plates alone. Radial pieces of the calcareous ring with long, slender, bifurcate prolongations posteriorly; all the ten pieces simple.

Habitat.—Red Sea (Selenka).

2. *Deposits in the shape of tables.*

Thyone fusus (*Holothuria*), O. F. Müller, 1788 and 1789; Koren, 1844; Düben and Koren, 1844. *Holothuria penicillus*, O. F. Müller, 1788 and 1789. *Holothuria papillosa*, O. F. Müller, 1789. *Mülleria papillosa*, Johnston, 1834. *Thyone papillosa*, Forbes, 1841. *Anaperus fusus*, Troschel, 1846. (?) *Holothuria scotica*, Dalyell, 1851. *Thyonidium pellucidum*, Barrois, 1882.

Tables not very close together, composed of an irregular oval or angular disk, mostly with only four holes, but sometimes also with smaller peripheral ones; spire of the tables made up of two rods anastomosing at the top and terminating in small spines.

Habitat.—Scandinavia from the Sound northwards to Lofoten (Sars, Düben and Koren, Koren, Danielssen and Koren, Danielssen, Möbius), British Islands (Thompson, Forbes, Johnston, O. F. Müller, Norman, M'Intosh, Hodge, Herdman, Leslie and

Herdman, &c.), west coast of France (Barrois), Mediterranean Sea (Ludwig, Græffe, von Marenzeller, Sars, &c.).

(Mus. Holm.) Numerous specimens dredged at the west coast of Sweden. Body fusiform, inconsiderably curved. Pedicels tightly placed all over the body. Calcareous ring large; in an individual, 60 mm. long, its length was 20 mm. and breadth 9 mm.; the slender bifurcated prolongations of the radial pieces were 8 mm. long. In some specimens the ten pieces are obviously simple, in others they appear to be composed of several smaller parts, which, however, are not very distinct. Anal teeth more or less minute.

Thyone villosa, Semper, 1868.

Habitat.—Zebu (Semper).

This species must be nearly related to the former, and, in reality, I cannot find out any definite distinctions. The pedicels may possibly be finer and more closely placed in *Thyone villosa*. Semper does not give any description of the deposits, but only a figure, which, however, cannot be fully satisfactory for communicating an idea of their true shape; judging from this figure, I am much inclined to consider the deposits of this species as nearly like those in the preceding. *Thyone venusta* of Selenka also bears the closest resemblance to *Thyone fusus*, only differing from it in the want of deposits.

Thyone scabra, Verrill, 1873. (?) *Thyone fusus*, Verrill, 1873.

Deposits—tables composed of an oval, or triangular, or subpolygonal disk with twenty to twenty-four holes, and a spire built up of two anastomosing rods.

Habitat.—Coast of New England (Verrill).

Verrill does not mention anything about anal teeth or calcareous ring, he only declares that the species in question resembles *Thyone raphanus* in form. It may possibly be devoid of anal teeth (?).

3. *Deposits in the shape of perforated plates.*

Thyone raphanus, Düben and Koren, 1844; Hodge, 1872; von Marenzeller, 1878.

The plates are rather large, closely crowded and overlapping. Very seldom minute × -shaped deposits may be found. Body curved with a long slender caudal portion.

Habitat.—Scandinavian west coast northwards to Molde and Christiansund (Düben and Koren, Storm, Sars, Danielssen and Koren), British Islands (Norman, Hodge, Kinahan, Théel, Herdman, &c.), Mediterranean Sea (von Marenzeller, Marion, Ludwig).

(Mus. Holm.) A few specimens dredged off the west coast of Sweden.

"Porcupine" Expedition.—Some large specimens from the Minch.

Thyone poucheti, Barrois, 1882.

Habitat.—West coast of France (Barrois).

This species, if it be really distinct, seems to be one of the nearest relatives of *Thyone raphanus*, from which it differs mainly in the calcareous plates being of a more irregular form, and provided with knobs on their upper surface. "Porcupine" Expedition dredged one specimen at Station 6, 1870, from a depth of 358 fathoms, which may probably be referred to this form. The form of the body, the anal teeth, &c., are like those in *Thyone raphanus*, but the skin is rougher. The deposits partly resemble those described by Barrois, being irregular and plate-like with numerous holes and small knobs; a few become scale-like in that the knobs are united so as to form a thicker reticulate network composed of superposed layers. Length 20 to 30 mm.

III. Calcareous ring composed of ten pieces, each made up of a number of small parts; posteriorly it carries five bifurcate prolongations.

Thyone buccalis, Stimpson, 1856; Semper, 1868.

Deposits—closely crowded, oval knobbed buttons with four holes. Calcareous ring very long, composed of numerous small pieces, and sending posteriorly five long slender, bifurcate prolongations.

Habitat.—Port Jackson (Stimpson), Rockhampton and Port Mackay (Semper), (?) Port Denison (Bell).

(Mus. Holm.) Two specimens from Rockhampton. Body fusiform, indistinctly four or five angled. Mouth with five ridges like that in *Colochirus*. Tentacles ten, three or four ventral smaller. Anal teeth minute. Pedicels equally distributed all over the body, the dorsal apparently running out from low warts. Calcareous ring made of a great number of small pieces, carrying anteriorly ten shorter processes and posteriorly five long slender bifurcated prolongations. Six to eight Polian vesicles and numerous small madreporic canals. Body-wall thick and hard from crowded oval buttons, which are knobbed round the margin, and, as a rule, pierced with four holes; an arch rises vertically to the buttons themselves from each surface. Some of the buttons much smaller and more finely constructed. Pedicels supported by large curved rods, enlarged and perforated with several holes at the middle, and even pierced at the slightly dilated ends; some of the rods are three-armed. Terminal plates are also present in the pedicels. Length of the largest specimen 75 mm. Colour in alcohol, darker or lighter brown; tentacles blackish.

The species completely resembles *Thyone sacella*, excepting that the latter is devoid of anal teeth, which are present in *Thyone buccalis*, though they are very rudimentary. Possibly they may be proved to be identical.

Thyone aurantiaca (*Uroxia*), Costa, 1869; von Marenzeller, 1874; Ludwig, 1880. *Haplodactyla mediterranea*, Taschenberg, 1879.

Tables present only in the posterior extremity of the body, composed of a disk pierced with about four larger and four smaller holes; their spires made up of two anastomosing rods.

Habitat.—Mediterranean Sea (v. Marenzeller, Greeff, Ludwig).

"Porcupine" Expedition.—Three specimens from Tangiers Bay, which probably belong to this species, though their deposits were destroyed. The calcareous ring completely resembles that figured by Ludwig. The species must be very closely allied to *Thyone fusus*.

B. Anus devoid of calcareous teeth.

I. Calcareous ring of ten simple pieces, without posterior prolongations.

1. *No deposits in the body-wall itself.*

Thyone meridionalis, Bell, 1883.

Pedicels "absent from the greater part of the bivial surface, well enough developed above, and diminishing in number on either side as they approach the bivium." Very sparsely distributed rods in the pedicels. Tentacles nearly equal.

Habitat.—Strait of Magellan (Bell).

The species is doubtless nearly allied to *Thyone spectabilis*.

2. *Deposits present under several forms.*

Thyone rosacea, Semper, 1869.

Deposits—cruciform bodies and minute grains. Pedicels with long, straight, smooth rods, with the slightly dilated ends branched.

Habitat.—Aden (Semper).

Thyone cunninghami, Bell, 1883.

Deposits—delicate rods, often pitchfork-shaped, or swollen and perforated at their ends, sometimes more irregular in form. Anus fringed with papillæ.

Habitat.—Off Dungeness, Patagonia (Bell).

This species may probably be only a *Thyone spectabilis*.

Thyone gemmata (*Colochirus*), Pourtalès, 1851; Ayres, 1854; Semper, 1868. *Thyonidium gemmatum*, Selenka, 1867. *Thyonella gemmata*, Verrill, 1872. (?) *Thyonella* sp., Rathbun, 1879.

Deposits—oval button-like plates with undulated margins, uneven surfaces, and about four holes; and reticulate cups with the often incomplete margin spinous or uneven. Pedicels in five distinct longitudinal series, and scattered over the interjacent areas.

Habitat.—Sullivan's Island (Pourtalès), North Carolina (Verrill), South Carolina (Ayres, Selenka), Fort Macon (Coues and Yarrow), Florida Reef (Pourtalès) (?) Bahia (Rathbun).

According to Ayres, the radial pieces of the calcareous ring are prolonged posteriorly into two slender branches. Judging from the figure given by Selenka, they are only slightly excavated posteriorly.

II. Calcareous ring of ten simple pieces, the radial with a bifurcate prolongation posteriorly.

Thyone ovulum (*Stolus*), Selenka, 1867; Semper, 1868.

Excepting terminal plates in the pedicels, no deposits. Pedicels very numerous.

Habitat.—Acapulco (Selenka).

Thyone mirabilis, Ludwig, 1875.

Deposits—scattered tables, composed of a roundish perforated disk and a spire of two anastomosing rods. Body slightly quadrangular, with a row of small warts along the dorsal ambulacra. Ventral pedicels much more numerous than the dorsal.

Habitat.—Bowen (Ludwig), Port Denison (Bell).

III. Calcareous ring of ten pieces, each composed of a great number of small parts; posteriorly it carries five bifurcate prolongations.

Thyone sacella (*Stolus*), Selenka, 1867; Semper, 1868; von Marenzeller, 1881. *Thyone rigida*, Semper, 1868.

Deposits—Numerous, somewhat irregularly formed bodies, consisting of a plate with four holes and a smaller bow vertically disposed on each side, thus presenting the view of two rings placed vertically to one another; the larger plate or ring has the undulating rim provided with low elevations.

Habitat.—Bohol (Semper), Japan (von Marenzeller), Torres Strait (Bell), Aden (Semper), Zanzibar (Selenka), Mozambique (Semper).

Thyone gibber (*Stolus*), Selenka, 1867; Semper, 1868.

Deposits like those in *Thyone gemmata*—oval button-like plates with about four holes; and reticulate cups. The pieces of the calcareous ring are firmly united.
Habitat.—Panama (Selenka).

Thyone okeni, Bell, 1884.

Excepting terminal plates in the pedicels, no deposits. Pedicels closely packed.
Habitat.—Port Jackson (Bell).

IV. Calcareous ring composed of five radial pieces alone.

Thyone chilensis, Semper, 1868.

Deposits—spinous rods, sometimes pierced with a few holes. Tentacles of nearly equal size.
Habitat.—Chili (Semper).

The following species are more or less incompletely known and need re-examination:—

Thyone pulcherrima (*Pentamera*), Ayres, 1854; Semper, 1868.

Habitat.—South Carolina (Ayres, Stimpson), North Carolina (Verrill), from South Carolina to Vineyard Sound (Verrill), Fort Macon (Coues and Yarrow).
Judging from the description of Ayres, the pedicels are confined to the ambulacra, forming three well-defined double rows. Semper says that they are present, though rarely, even on the interambulacra. Anus armed with five teeth. Calcareous ring composed of ten pieces, the radial with a posterior bifurcate prolongation. Deposits in numerous, inseparable, perforated layers, their true shape not fully clear. It seems doubtful whether the species really belongs to this genus.

Thyone muricata (*Trachythyone*), Studer, 1877.

Habitat.—Kerguelen (Studer).
This species is a true *Thyone*, though its pedicels run out from conical papillæ. Anus with five teeth. Deposits—oval or triangular plates, perforated with several larger and some smaller holes; they are closely crowded.

Thyone peruana (*Holothuria*), Lesson, 1830; Selenka, 1867 and 1868. *Trepang peruviana*, Jæger, 1833. *Anaperus peruanus*, Troschel, 1846. *Anaperus carolinus*, Troschel, 1846. *Thyone carolina*, Selenka, 1867. *Thyone tenella*, Selenka, 1867 and 1868.

Habitat.—Peru (Troschel), Texas (Selenka), South Carolina (Troschel, Pourtalès).

This species seems to be very unsatisfactorily known. I am much inclined to refer Troschel's *Anaperus carolinus* to *Thyone briareus* of Lesueur. Even Selenka's *Thyone tenella* may without difficulty be referred to the same species, considering that its deposits, figured by Selenka, have certainly supported the pedicels and not the body-wall itself, which will easily be seen from the elongated curved disks of the tables. Whether Lesson's and Troschel's *Thyone peruana* are distinct species or not, cannot be stated at present.

Thyone cigaro (*Anaperus*), Troschel, 1846; Selenka, 1867. *Stolus cigaro*, Selenka, 1868.

Habitat.—Labrador (Troschel).

Seven longer and three shorter tentacles. Pedicels large, crowded. Anus without teeth, but with papillæ. Calcareous ring unknown. Deposits in the perisome absent.

Thyone glabra (*Thyonidium*), Ayres, 1854; Semper, 1868.

Habitat.—George's Bank (Ayres).

Tentacles—three longer, three smaller, two still shorter, and two very short. Pedicels not numerous. Calcareous ring of ten simple pieces, the radial not prolonged posteriorly. Deposits of the perisome absent.

When comparing the imperfect descriptions of these two last forms, one is scarcely able to point out a single distinguishing character of importance. The aberrant conformation of the tentacles is doubtless an individual abnormality, and the number of Polian vesicles and madreporic canals is known to vary in the same species. Both forms agree in the absence of deposits in the body-wall itself, and they are obtained from localities not very distant.

Thyone pedata, Semper, 1868.

Habitat.—China Sea (Semper).

No anal teeth. Ventral pedicels longer and much more crowded than the dorsal. Calcareous ring composed of ten pieces, the interradial simple, the radial having the ends of their posterior prolongations made up of separate small parts. Deposits present, but their shapes unknown.

Thyone musculosa (*Thyonidium*), Ayres, 1854; Semper, 1867.

Habitat.—Massachusetts Bay (Ayres).

Thyone longidentis, Hutton, 1872. *Pentadactyla longidens*, Hutton, 1879.

Habitat.—New Zealand (Hutton).

The descriptions of Hutton are very defective, and certainly give a wrong idea of the species in question. In his later "Notes" Hutton says that the species "belongs to the family Aspidochirotæ, and must form the type of a new genus distinguished by having only five tentacles," &c. Judging from his description of the "dental apparatus," which is "very long, nearly half the length of the body, tubular for half its length, the rest cut into five teeth," I suppose the species to be a Dendrochirote, though possibly not a *Thyone*.

Thyone brevidentis, Hutton, 1872.

Habitat.—New Zealand (Hutton).

Thyone aurea (*Holothuria*), Quoy and Gaimard, 1833; Semper, 1868. *Cladolabes aureus*, Brandt, 1835.

Habitat.—Cape of Good Hope (Quoy and Gaimard).

Thyone inermis, Heller, 1868.

Habitat.—Mediterranean Sea (Heller).

Excepting a network in the ends of the pedicels, no deposits.

Thyone andrewsii, Farran, 1852 (according to Kinahan, 1859).

Habitat.—Ireland (Farran and Kinahan).

Thyone flexus, Hodge, 1865.

Habitat.—Northumberland (Hodge).

Thyone elegans, Norman, 1868.

Habitat.—Shetland (Norman).

Excepting terminal plates in the pedicels and irregular cribiform plates in the tentacles, no deposits. Skin thin, very delicate. Pedicels numerous, scattered all over the body.

(?) *Thyone elongata* (*Thyonidium*), Ayres, 1851. *Orcula elongata*, Semper, 1868.

Habitat.—George's Bank (Ayres).

Thyone floccosa, Norman, 1864.

Habitat.—British Islands (Norman).

Genus 10. Stereoderma, Ayres, 1854.

Tentacles ten, two ventral smaller. Ambulacral appendages in the shape of pedicels, scattered irregularly over the body, but having a tendency to form a regular double-row in some parts of the trivium. Anus without teeth. Integument hard.

Stereoderma unisemita (*Anaperus*), Stimpson, 1854; Ayres, 1854; Selenka, 1867. *Cucumaria fusiformis*, Desor, 1851 (according to Verrill).

Calcareous ring, like that in *Psolus phantapus*, of ten simple pieces without posterior prolongations. Deposits—numerous crowded, thick, oval, smooth plates or rather buttons with four holes. Pedicels in want of terminal plate and nearly destitute of other deposits. The double row of pedicels is somewhat irregular, and placed on one side (according to Stimpson), or forms a well-defined line beneath (Ayres), or forms a double row along the right (or left) side of the body (Selenka).

Habitat.—Grand Bank and the coast of New England (Stimpson), Newfoundland and Massachusetts (Ayres), off Martha's Vineyard (Verrill), Nantucket (Desor), (?) Cape Palmas (Selenka).

Stereoderma murrayi, Bell, 1883.

The double row of pedicels only well developed in the anterior third of the body. Calcareous ring composed of numerous small plates, and carrying five long slender prolongations posteriorly. Deposits—numerous crowded, oval plates, with uneven or undulated margin, pierced with four holes and provided with lower or higher elevations round the margin; on the upper and under surfaces a half-ring is placed so as to form together a complete smaller ring, vertical in position to the plate itself.

Habitat.—Kurrachee (Bell).

I am almost convinced of the identity of the two forms *Stereoderma murrayi* and *Thyone sacellus*, which supposition is supported by the presence of the thick hard perisome with its unusually shaped deposits, the characteristic calcareous ring, &c. Some very unimportant differences exist:—*Stereoderma murrayi* is of a

white colour, possibly a result of the alcohol, with dark tentacles, and has only one Polian vesicle (madreporic canals unknown); *Thyone sacellus* is of a dark brown colour, has four Polian vesicles and twelve to twenty madreporic canals.

Stereoderma validum, Bell, 1884.

Habitat.—Port Jackson, North Dunbar Island, China Sea (Bell), between Ball's Head and Goat Island, Brisbane Water (Bell).

So far as I can find out from the description of Bell, this form cannot be anything else than a *Colochirus spinosus*, Quoy and Gaimard. Evidence of the correctness of this view is to be found in the form of the body, the presence of the characteristic conical denticulate prominences on each side of the ventral surface, the calcareous ring and even the general appearance of the calcareous deposits, though it may be observed that Bell does not mention anything about the presence of reticulate scales in the forms examined by him. Thus, if I am right in my supposition, *Stereoderma murrayi* is a *Thyone sacella* and *Stereoderma validum* a *Colochirus spinosus*. Finally, I feel convinced that further examinations will prove that *Stereoderma unisemita* may be referred to some already well-known genus, for instance *Thyone*.

Genus 11. Thyonidium, Düben and Koren, 1844.

Tentacles twenty, exceptionally fewer or more; five pairs of larger alternating with five pairs of smaller. Ambulacral appendages in the shape of pedicels, sometimes densely crowded, sometimes more thinly scattered; often an arrangement of them in rows distinguishable along the ambulacra.

I. Deposits of the body-wall itself, none, or present in the form of tables or plates in the neck portion alone.

Thyonidium drummondii (*Holothuria*), Thompson, 1840; Sars, 1861. *Cucumaria drummondii*, Forbes, 1841. *Cucumaria communis*, Forbes, 1841. (?) *Thyone portlockii*, Forbes, 1841. *Thyonidium commune*, Düben and Koren, 1844. *Holothuria fusus*, Œrsted, 1833 (according to Düben and Koren). *Thyonidium dübeni*, Norman, 1868.

Habitat.—Scandinavian coasts from the Sound to Lofoten (Sars, M'Andrew and Barrett, Danielssen, Düben and Koren, Lütken), British Islands (Thompson, Hodge, M'Intosh, Forbes, Norman).

(Mus. Holm.) Several specimens from the west coast of Sweden and Norway. So far as I can see, this species must be nearly allied to *Thyonidium pellucidum*,

and differs from it in some characters of more or less importance. Generally it seems to be larger, up to 160 mm. long, with closely placed pedicels, and often with the ambulacra indicated by a longitudinal furrow. It almost appears to be a rule, that the tentacles deviate somewhat from what is the typical condition in this genus. The calcareous ring is rather high, up to 17 mm. in the largest specimens; its radial pieces are excavated posteriorly so as to give rise to two short prolongations, but, considering that the ring in the specimens examined by me is much contracted and wrinkled, I am by no means sure of it, nor whether the pieces are simple or composed of some secondary parts, which sometimes seems to be the case. Excepting terminal plates in the pedicels, the body should be devoid of deposits, but in some specimens I have found tables in the cervical portion of the body. A single madreporic canal and two or three Polian vesicles. Norman says that the true *Thyonidium commune*, Forbes, differs from the Scandinavian form, described under the same name by Düben and Koren, in having the skin covered with tables which have a nearly circular disk with numerous perforations and a spire built up of four rods. Now my own researches show that the Scandinavian form also has deposits in the shape of tables, though principally in the cervical portion of the body. Norman does not point out in what respects his *Thyonidium commune* differs from *Thyonidium pellucidum*, nor does he say whether he has examined the types of Forbes and Thompson. It appears very probable that his species is only a *Thyonidium pellucidum*.

Thyonidium productum (*Duasmodactyla*), Ayres, 1854 and 1873; Stimpson, 1854. (?) *Orcula punctata*; Agassiz, 1852 (according to Stimpson).

Habitat.—East Port (Ayres), Grand Manan (Stimpson).

Deposits in the shape of "irregular perforated plates" present only in the cervical portion. Probably this species is not distinct from the preceding one.

II. Deposits of the body-wall itself absent, or present in greater or smaller number in the form of spinous rods.

Thyonidium molle (*Pattalus*), Selenka, 1868; Semper, 1868. *Thyonidium peruanum*, Semper, 1868. *Pattalus peruvianus*, Verrill, 1867 to 1871. *Anaperus peruanus*, Verrill, 1867 to 1871.

Tentacles varying from sixteen to twenty-one, sometimes typical; often, however, a typical in being of nearly equal size. Calcareous ring of ten simple pieces, the radial much higher than the interradial, and devoid, as it seems, of true posterior bifurcate prolongations. Deposits, when such are present, irregular, slightly spinous rods pierced by some holes.

Habitat.—Chili (Selenka, Semper, Ludwig), Peru (Selenka, Semper), Paita and Callao (Verrill).

(Mus. Holm.) One individual, 110 mm. long, dredged at Iquique. Colour brownish; tentacles darker. Tentacles nineteen, unequal, but in an irregular manner. Pedicels equally distributed all over the body. Excepting terminal plates in the pedicels, no deposits seem to be present. A single madreporic canal and numerous Polian vesicles. Each of the strong retractors appears as if it were composed of several distinct bands.

III. Deposits of the body-wall itself in the shape of tables.

1. *Calcareous ring of ten simple pieces, the radial not prolonged posteriorly.*

Thyonidium pellucidum (*Holothuria*), Fleming, 1828; Düben and Koren, 1844. *Cucumaria hyalina*, Forbes, 1841. *Pentacta pentactes*, Œrsted, 1833. *Thyonidium hyalinum*, Lütken, 1857. (?) *Thyonidium conchilegum*, Pourtalès, 1868 and 1869.

Tables rather scattered, excepting in the cervical portion of the body, where they are crowded, consisting of a regular, round, perforated disk with nine to twelve peripheral holes, and a spire built up of three to four rods terminating in spines and connected by a transverse beam near the top.

Habitat.—Scandinavian coasts from Finmark to the Sound (Sars, Storm, Düben and Koren, Ludwig, Lütken, Möbius and Bütschli, Danielssen, &c.), Arctic Sea north from Norway (Hoffmann), Mohn Bay (Heuglin), Spitzbergen (Ljungman), White Sea (Jarzynsky), British Islands (Hodge, Fleming, Forbes, Norman), North Atlantic Ocean, north of Shetland, at a depth of 1081 fathoms (Danielssen and Koren), Florida Reef (Pourtalès).

(Mus. Holm.). Several specimens from the west coast of Sweden. One fully typical individual may be described. Length, 55 mm. Body-wall white, slightly transparent, the five muscular bands being visible through it. Tentacles twenty, typical. Besides a double row of pedicels along the ambulacra, the interambulacra bear pedicels which, scattered without order on the dorsal surface, seem to be placed more or less distinctly in longitudinal rows on the ventral interambulacra. Anus surrounded by pedicels, distinguished from the true pedicels by having a very rich covering of irregular, reticulate, calcareous bodies, thus forming a transition to anal teeth. Even anteriorly on the body, the pedicels are supported by such irregularly perforated plates, though not so abundantly. On the rest of the body, the pedicels have, excepting terminal plates, none or a few supporting plates, but no rods. The tables, very thinly scattered, excepting at the cervical portion, where they are more aggregated, consist of a rather large perforated disk supporting a spire composed of three or four rods, one transverse beam, and terminating in several, sometimes as many as twelve

teeth. The disk is pierced with several—up to twelve—smaller peripheral holes around the large central ones, and has never, or at least very seldom, the margin smooth, but angular, or provided with small processes. A single Polian vesicle and madreporic canal. The genital organs attached far posteriorly, about 20 mm. behind the tentacles. Calcareous ring small, slender, about 3 mm. high, with the posterior margin wrinkled or angular, but devoid of posterior prolongations. The ten pieces of the ring are simple and slightly excavated posteriorly.

Thyonidium marionii (*Cucumaria*), von Marenzeller, 1878.

Habitat.—Mediterranean Sea (von Marenzeller, Marion, Ludwig).

In a letter von Marenzeller kindly informs me that his *Cucumaria marionii* is a *Thyonidium* with twenty tentacles, the smaller pairs having at first escaped his attention. Considering the smallness of the only individual hitherto obtained, it is very probably a young one, which also explains the absence of pedicels on the interambulacra; the species must be allied to the former, if not identical with it. Its deposits consist of tables with a rounded rhomboidal regularly perforated disk and a spire built up of only two rods. The radial pieces of the calcareous ring not so deeply excavated posteriorly as the interradial.

2. *Calcareous ring of ten simple or compound pieces, always with five radial posterior bifurcate prolongations, made up of several separate parts or joints.*

Thyonidium cebuense, Semper, 1868.

The posterior prolongations of the five radial pieces of the calcareous ring are composed of three separate pieces or joints. The five interradial pieces terminate anteriorly in a single conical point, the radial in four small ones.

Habitat.—Cebu (Semper).

The tables, not described but only figured by Semper, seem to consist of a roundish disk perforated with one central and several, about eight, peripheral holes and a spire of four rods.

Thyonidium magnum, Ludwig, 1882.

Calcareous ring "elongated posteriorly and spirally coiled." The tables consist of a disk perforated with four central and numerous much smaller peripheral holes; their spire is built up of two rods terminating in two to four points and strengthened by one transverse beam. Anteriorly, the ambulacra alone carry pedicels.

Habitat.—Amboina (Ludwig).

From the summary description of the calcareous ring, one cannot get an exact idea of its shape, whether it is composed of a large number of small pieces.

Thyonidium parvum, Ludwig, 1881 and 1882.

The ten pieces of the calcareous ring narrow, slender; the posterior two prolongations of the radial pieces composed of several separate parts or joints. The tables are smooth on the margin, consist of an oval disk, as a rule, pierced with eight larger peripheral and two smaller central holes, and a spire made up of two short rods connected at the top by a transverse beam, the top of the spire terminating in about eight spines.

Habitat.—Brazil (Ludwig).

The species is an exception to the rule in having only eighteen tentacles, nine larger and nine smaller.

Thyonidium occidentale, Ludwig, 1875.

The radial and interradial pieces of the calcareous ring simple, but between them a small calcareous wedge; the radial having their posterior prolongations short and composed of small particles. Tables consisting of a rather well-developed perforated disk with uneven dentate margin, and a spire reduced to four short spines united at their bases.

Habitat.—Surinam (Ludwig).

Thyonidium caudatum (*Thyone*), Hutton, 1872.

Body more tapering posteriorly so as to form a narrow caudal portion. Anal teeth very rudimentary, made up of a minute calcareous network. Tentacles twenty, typically arranged. Pedicels numerous all over the body, placed on low but distinct papilla-like warts, excepting at the caudal portion, where no warts are visible and the pedicels seem to form double rows on the ambulacra, the interambulacra being there naked. Calcareous ring, about 30 mm. long, is made up of a great number of small pieces, and terminates posteriorly in five slender bifurcate prolongations. Anteriorly the interradial parts of the ring terminate in a single conical top, the radial in four small teeth. Body-wall very rough from numerous larger or smaller tables; their disks are irregularly formed, smooth, elongated, fusiform, three-armed or angular with numerous holes, the four central of which are often larger; their spire is in the shape of a long simple conical spine, the base of which seems to be composed of two or more rods. Towards the top of the warts the spines become more solid and larger. Pedicels supported by such tables and a very rudimentary terminal plate. In the caudal portion of the body the disks of the tables are elongated, fusiform, and transverse in position. A single Polian vesicle and madreporic canal. Colour rusty brown; caudal portion and warts lighter yellowish. Length, 100 mm. or more. Very nearly allied to the following species.

(Mus. Holm). Two type specimens dredged at New Zealand, presented by Hutton.

IV. Deposits of the body-wall itself in the shape of simple plates.

Thyonidium japonicum, v. Marenzeller, 1881.

Calcareous ring almost like that in the preceding species. Deposits—crowded, irregular, perforated smooth plates of variable shape. The pedicels with tables, like those in the preceding species, consisting of an irregular curved disk supporting a long spine; in the pedicels of the anterior part of the body, even, irregular, perforated plates with rudimentary spire, and, besides, numerous small rods (incomplete rosettes) with the dilated ends perforated and branched.

Habitat.—Japan or China (von Marenzeller).

This species resembles the preceding one in general shape and other respects.

V. Deposits of the body-wall itself in the shape of rods.

Thyonidium schmeltzii, Ludwig, 1875.

One of the slightly enlarged ends of each of the rods is furnished with spines, the other is perforated; for the rest, the rods are smooth. The radial pieces of the calcareous ring prolonged into two slender posterior processes, the narrow interradial into one; all these processes composed of several separate pieces or joints.

Habitat.—Bowen and Gulf of St. Vincent (Ludwig), Warrior Reef and Torres Strait (Bell).

(Mus. Holm.) One very small individual, 12 mm. long, dredged at Pelew Islands. Colour brownish. It possesses the very characteristic deposits, which have the outwardly directed slightly enlarged end head-like and spinous, so that the rod resembles a club armed with nails.

The following species is too unsatisfactorily known and should be re-examined:—

Thyonidium ehlersi, Heller, 1868.

Deposits—tables composed of a round disk perforated with about eight peripheral holes and having the margin spinous; their central spire is made up of four rods.

Habitat.—Mediterranean Sea (Heller).

The species is probably very closely allied to *Thyonidium pellucidum*.

Thyonidium flavum, Greeff, 1882.

Deposits—very few disks composed of tightly crowded grains, and, also, scattered simple grains. Besides scattered pedicels in the interambulacra, more or less distinct double rows are present on the ambulacra.

Habitat.—Rolas (Greeff).

The species is not well known.

Genus 12. Orcula, Troschel, 1846.

Tentacles fifteen, five smaller alternating with ten larger. Ambulacral appendages in the shape of pedicels distributed over the ambulacra as well as interambulacra; an arrangement of them in rows seldom discernible on the ambulacra.

1. *Deposits in the body-wall itself absent.*

Orcula barthii, Troschel, 1846; Lutken, 1857; Duncan and Sladen, 1881.

Pedicels irregularly scattered. Calcareous ring of ten simple pieces, all bifurcate posteriorly, the radial terminating anteriorly in two points, the narrow interradial in one.

Habitat.—Greenland (Lütken, Norman, Duncan and Sladen), Labrador (Troschel) Sea of Kara (Stuxberg), (?) Spitzbergen (Ljungman).

Orcula limaconotus (*Cladolabes*), Brandt, 1835; Ludwig, 1881.

Habitat.—Boninsima (Brandt).

From the researches hitherto made, it is impossible to state whether this species is distinct from the preceding or not. The statement that *Orcula limaconotus* has several, up to nine, Polian vesicles, while *Orcula barthii* has only a single one, seems to be of little or no importance.

2. *Deposits in the body-wall itself present.*

Orcula tenera, Ludwig, 1875.

Pedicels irregularly scattered. Calcareous ring of ten simple pieces, "all" with two posterior slender prolongations composed of several separate pieces or joints. Deposits—very few tables and minute grains, the former composed of a roundish perforated disk and a spire built up of four (?) rods and one transverse beam.

Habitat.—Upolu in Navigator Islands (Ludwig).

Orcula hypsipyrga, von Marenzeller, 1881.

Pedicels irregularly scattered. Calcareous ring of ten simple pieces, the radial alone with two long slender posterior prolongations composed of several separate pieces or joints. The ends of these prolongations are united with those of the adjacent radial pieces. Deposits—tables consisting of a roundish disk with numerous holes, and a central spire built up of four to six rods and several transverse beams; the spire terminates in several spines.

Habitat.—Japan or China (von Marenzeller).

Orcula cucumiformis, Semper, 1868.

Larger pedicels in a double row along the ambulacra, and a few smaller scattered on the interambulacra. Calcareous ring of ten simple pieces, the radial with two posterior prolongations composed of several separate pieces or joints. Deposits—large scattered plates.

Habitat.—Cape York (Semper), Port Molle (Bell).

The following two species of *Orcula* are unsatisfactorily known:—

Orcula punctata, Selenka, 1867 and 1868.

Habitat.—Charleston (Selenka).

A very dubious form. Judging from the first description of Selenka, one must feel inclined to refer it to the northern form *Orcula barthii*, but lately in his "Nachtrag" Selenka declares *Orcula punctata* of Agassiz to be identical with *Thyonidium productum*, Ayres. Selenka, however, does not explain whether his *Orcula punctata*, described in 1867, represents the type of Agassiz mentioned by Selenka in 1868. Besides, it remains unexplained how *Thyonidium productum*, with twenty tentacles, and *Orcula punctata*, with fifteen tentacles, can be synonymous.

Orcula lapidifera (*Holothuria*), Lesueur, 1824; Semper, 1868. *Phyllophorus* (?) *lepadifera*, Verrill, 1867–1871.

Tentacles sixteen. Incomplete description. Possibly belonging to another genus.

Habitat.—St. Bartholomew (Lesueur).

Genus 13. Phyllophorus, Grube, 1840.

Tentacles forming two crowns, twelve to sixteen in the exterior and five to six in the interior. Ambulacral appendages almost without exception in the shape of pedicels, irregularly distributed all over the body.

I. Pedicels cylindrical, all of the same shape.

1. *Deposits in the shape of rods.*

Phyllophorus perspicillum (*Urodemas*), Selenka, 1867; Semper, 1868. *Orcula perspicillum*, Semper, 1868.

Fifteen larger tentacles in the exterior crown, and five smaller (?) in the interior. Deposits—spectacle-like rods with a hole at each end, sometimes also with a

central hole, or with only one end perforated. Mouth stellate, closed by five groups of eight to ten papillæ in each. Calcareous ring of ten simple, flexible, spongy pieces, each bifurcated posteriorly; the pieces are not united with each other.

Habitat.—Sydney (Selenka), Port Denison and Port Stephens (Bell).

The relative size of the tentacles and their position are not fully clear, wherefore further investigations are required to prove whether this species really belongs to the genus in question or is to be referred to *Orcula*, in which case the diagnosis of the latter genus must be changed.

Phyllophorus ehrenbergii (*Urodemas*), Selenka, 1868; Semper, 1868.

Fifteen larger tentacles in the outer crown, and five smaller in the inner. Deposits—numerous spinous, not perforated rods, arranged three and three; one always thicker and longer than the other two. Calcareous ring, as it seems, of ten simple pieces, the radial considerably larger and carrying two posterior prolongations, which are simple and not divided into joints.

Habitat.—Red Sea (Selenka).

Phyllophorus frauenfeldi, Ludwig, 1875. *Phyllophorus*, n. sp., Semper, 1868.

Fifteen larger tentacles in the outer crown, and five smaller in the inner. Deposits like those in the preceding species, consisting of rods with four simple or bifurcate spines round the middle and four simple ones at each end. Calcareous ring of ten simple pieces, the radial slightly larger and bearing posteriorly two slender prolongations divided into joints.

Habitat.—Red Sea (Ludwig, Semper).

Semper also figures a rosette-shaped body found in the perisome, but there is nothing mentioned about such in the description of Ludwig; he only refers to the figures given by Semper. For my own part I cannot refrain from supposing that *Phyllophorus ehrenbergii* and *Phyllophorus frauenfeldi* are very nearly related, and that they may prove to be identical.

2. *Deposits—plates either of a more common shape, or button-like, or rosette-shaped.*

Phyllophorus dobsoni, Bell, 1883.

Twelve tentacles in the exterior crown and six in the interior. Pedicels irregularly distributed, but scarce or absent in the central portion of the ventral surface. Deposits—numerous thick, discoidal bodies, with serrate margin, with a few (about four) small perforations and a number of minute conical knobs.

Calcareous ring of ten simple pieces, the stout radial pieces devoid of true processes posteriorly.

Habitat.—Bay of Honduras (Bell).

Bell speaks of "short and feeble, backwardly directed processes" on the radial pieces of the calcareous ring, but, according to his drawings, the posterior margin of the named pieces is slightly uneven but devoid of processes. The deposits bear some resemblance to buttons.

Phyllophorus proteus, Bell, 1884.

Deposits—more or less four-sided, smooth plates with four larger holes and several, about four pairs, of processes in the margin. The pedicels strengthened with roundish disks resembling agglomerations of minute grains. Calcareous ring of ten simple pieces, all deeply excavated anteriorly; the radial ones obtuse, the interradial pointed posteriorly.

Habitat.—Port Molle, Clairmont and Thursday Islands, Alert Island (Bell).

Nothing is known about the arrangement of the tentacles, hence there may be some doubt whether the species really belongs to this genus.

Phyllophorus gracilis (*Urodemas*), Selenka, 1868; Semper, 1868.

Fifteen larger external tentacles, and five smaller internal. Deposits—scattered, irregular, knobbed, perforated rosette-shaped plates. Calcareous ring of ten simple pieces, the interradial ones small, the larger radial with two posterior slender appendages articulating with the main pieces.

Habitat.—Red Sea (Selenka).

A re-examination and careful comparison of the three species living in the Red Sea appear to be necessary.

3. *Deposits—tables, sometimes with the disk more or less reduced.*

Phyllophorus urna, Grube, 1840; Sars, 1857. *Holothuria penicillus*, Delle Chiaje, 1828. *Phyllophorus penicillus*, Delle Chiaje, 1841.

Tentacles varying, twelve to sixteen larger in the exterior crown and five smaller in the interior crown. Deposits—very thinly scattered tables, composed of a roundish perforated disk, with about eight peripheral holes, and a spire built up of four rods and one transverse beam; and minute grains. Calcareous ring of ten simple pieces, the radial with two long posterior prolongations.

Habitat.—Mediterranean Sea (Grube, Sars, Ludwig, &c.).

(Mus. Holm.) Two large specimens from Naples and four from Cagliari. Excepting rods and terminal plates in the pedicels, and some minute granular oval bodies, I detected scarcely a single deposit. I counted sixteen larger external and four smaller internal tentacles. According to Sars, the older specimens are almost devoid of tables, and possess only some grains or granular bodies.

Phyllophorus holothurioides, Ludwig, 1875.

Tentacles eighteen, thirteen exterior, two ventral of which are much smaller, and five small interior. Deposits—tables consisting of an irregular, perforated disk with uneven, spinous margin, and a spire reduced to four or six spines. Calcareous ring of ten simple pieces, the radial ones larger and provided with two slender posterior prolongations, each divided into joints.

Habitat.—(?).

II. Ambulacral appendages of two kinds: smaller cylindrical pedicels only on the middle of the ventral surface, and larger conical granular papillæ or warts with pedicels on the rest of the body.

Phyllophorus granulatus (*Psolus*), Grube, 1840; Sars, 1857. *Hemicrepis granulatus*, Müller, 1853.

Tentacles twelve to thirteen in the exterior crown, and six smaller in the interior. Deposits—nearly absent on the middle portion of the ventral surface, but very closely crowded on the rest of the body, especially in the papillæ; they consist of irregular, perforated smooth plates and large, round, very thick reticulate scale-like ones. Calcareous ring of ten simple pieces, the radial with two slender undivided posterior prolongations.

Habitat.—Mediterranean Sea (Grube, Sars, Ludwig, &c.).

The following two species are incompletely known and need to be re-examined:—

Phyllophorus tenuis, Haacke, 1880; Ludwig, 1883.

Habitat.—Mauritius (Haacke, Ludwig).

Ludwig having seen the type-specimen, states that it is too defective to be re-examined. He does not seem to be sure whether it is a *Phyllophorus*.

Phyllophorus fusus (*Holothuria*), Delle Chiaje, 1828 and 1841.

Habitat.—Mediterranean Sea (Delle Chiaje).

Family IV. RHOPALODINIDÆ.[1]

Dorsal interradial space or bivium highly abbreviated and reduced, ventral surface enormously enlarged, consequently the body has a bottle-like appearance with mouth and anus placed close together in the same narrow proboscis-like pole

[1] Semper referred this peculiar Holothurid to a new class among the Echinodermata, which he called "*Diplostomidea*."

of the body; thus the anal and oral poles have been approximated side by side. Tentacles ten, pinnate. Genital pore on the very minute space between mouth and anus. Five double rows of pedicels along the middle portion of the body (viz., the enlarged part of the bottle); in consequence of the peculiar shape of the body the pedicels give the impression of being placed in ten double rows confluent at the larger rounded extremity.

Genus 1. Rhopalodina, Gray, 1853.

Rhopalodina lageniformis, Gray, 1853; Semper, 1868; Ludwig, 1877.

Body-wall stiff, from irregular, perforated plates and comparatively few tables, with a large perforated disk and a rudimentary spire. Four respiratory-trees. Anus with ten radial papillæ and five interradial teeth. Calcareous ring composed of ten irregular pieces. Anal portion of the intestine surrounded by ten regular pieces.

Habitat.—Congo coast (Gray).

Family ASPIDOCHIROTÆ.

Genus *Pælopatides*, n. gen.

Body more or less distinctly depressed, with a rather considerable brim surrounding it not only on the sides, but also round the extremities. Tentacles nineteen or twenty, of the shape common in Aspidochirotæ. Mouth ventral. Anus dorsal or subdorsal. Ambulacral appendages—pedicels and processes (=papillæ). The pedicels form a double row along the odd ambulacrum, excepting anteriorly where they are absent. The processes form a simple row round the margin of the brim which surrounds the body, and are, besides, scattered along each of the two dorsal ambulacra. Interambulacra naked. Two bundles of genital tubes present.

Pælopatides confundens, n. sp. (Pl. IX. fig. 7; Pl. X. figs. 1, 7).

Body very much flattened and depressed, elongated, almost equally broad or slightly narrower posteriorly, with the anterior and posterior extremities obtuse and rounded. Mouth completely ventral in position, surrounded by nineteen or twenty (?) retracted tentacles. Anus completely dorsal. The brim surrounding the body very considerable, and carrying on its margin a series of rounded low protuberances, which, especially round the anterior extremity of the body, are more prominent and pointed, almost

presenting the aspect of lobes. Each of these lobes or protuberances communicates with the water-vascular system. The odd ambulacrum with a double row of fully retractile pedicels, excepting in its anterior third which is naked. Each of the dorsal ambulacra with a simple row of thinly scattered, short, conical processes or papillæ. Calcareous deposits dissolved. Colour in alcohol, light brownish inclining to violet; in some specimens it is darker, nearly black on the ventral surface, especially along its middle. Length of the largest specimen about 300 mm., breadth at the middle of the body about 110 mm., height 20 to 25 mm. or less.

Habitat.—Station 298, November 17, 1875; lat. 34° 7′ S., long. 73° 56′ W.; depth, 2225 fathoms; bottom temperature, 35°·6; blue mud; three specimens. Station 299, December 14, 1875; lat. 33° 31′ S., long. 74° 43′ W.; depth, 2160 fathoms; bottom temperature, 35°·2; blue mud; a single very macerated individual. Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; depth, 1375 fathoms; bottom temperature, 35°·5; Globigerina ooze; six individuals.

The external aspect of this species bears a great resemblance to that of *Euphronides depressa*, though it is devoid of any larger odd dorsal process. In the largest specimen the breadth of the brim at the middle of the body is about 30 mm., and its anterior lobes are almost triangular with the base considerably broad. In the other specimens the anterior lobes are larger, more rounded, conical, and measuring up to 8 mm. in length, while the protuberances along the sides of the body are commonly less prominent, and mostly present themselves under the shape of small swellings in the margin of the brim. The dorsal processes do not seem to attain the same size as the lobes of the brim, but are commonly smaller. In one individual, 250 mm. long, dredged at Station 298 the number of ambulacral appendages was as follows:—about thirty pedicels arranged in a double row on the odd ambulacrum, about seventy-five closely placed lobes or protuberances forming a simple row round the margin of the body-brim, and fourteen or fifteen processes along each dorsal ambulacrum. In the largest specimen the dorsal processes are completely retracted and only visible as very flat almost inconspicuous warts with a small pit in the middle. The tentacles seem to be twenty, though I am not fully convinced of the accuracy of this number. In the largest individual the oral aperture is situated on the ventral surface about 35 mm. behind the anterior extremity of the body, and the anus lies on the dorsal surface about 13 mm. in front of the posterior extremity of the body. In one specimen some small warts surround the anal aperture.

The calcareous ring seems to be absent, or, more probably, dissolved by some impurity in the alcohol. The madreporic canal is not fully known. In the largest specimen two ventral Polian vesicles are present, one of which has a length of 145 mm., while the other only measures 90 mm. A thin bundle of genital tubes, several times branched, is situated on each side of the dorsal mesentery, and the common efferent

duct takes its beginning in the largest specimen at about 80 mm. behind the mouth. In all the specimens examined by me, excepting the largest one dredged at Station 298, the alimentary canal sends out anteriorly a large diverticulum, which, in an individual 160 mm. long, has a length of about 50 mm., and is situated about 50 mm. behind the water-vascular ring. It is held in a proper position by the mesentery to which it is attached. The cloacal dilatation of the intestine is considerable; the respiratory-trees are well developed, and both its branches run out from a common base; the left tree is shorter but more branched, its ramifications being in communication with the plexus of pseudhæmal vessels. The right tree attains almost the length of the body itself. At the base of these respiratory organs, a smaller bundle is often present. The longitudinal muscles are composed of two bands.

In the specimens obtained at Station 298 the calcareous deposits are totally absent, probably owing to some impurity in the alcohol. In the specimen from Station 299 some very fragmentary, irregular, three- or four-armed spicules are present, which commonly seem to bear an outwardly directed process, but I only found these deposits in the dorsal processes (Pl. X. fig. 1), and they were evidently in a state of solution. The integument is soft, thin, and pliable.

The specimen dredged at Station 299, measuring in length 235 mm. and in breadth about 70 mm., is much more macerated than those brought home from the other Station. I am by no means fully convinced of its identity with the latter specimens, but they present an obvious resemblance. Considering that the deposits are dissolved and the bodies themselves are very deformed and macerated, it is impossible to decide whether they are representatives of the same species or not. The individual from Station 299 has the Polian vesicles much shorter, only 30 mm. long, and the two thin bundles of reproductive organs have the tubes narrow and slender and up to four times (or more) dichotomously branched.

Having finished the above description founded on the specimens from Stations 298 and 299, I obtained the forms brought home from Station 300, in consequence of which some additions are necessary. These specimens, kept in purer alcohol, are less macerated, and their colour is dark violet, sometimes almost black; the middle part of the back commonly presents a lighter colour. The largest specimen measures in length slightly more than 300 mm., and its tentacles are nineteen. Though the calcareous ring is absent, the other deposits are not all spoiled. The general shape of the deposits of the perisome seems to be three-armed, with the ends of the arms slightly branched or pierced by a hole; the centre of each such deposit carries a strong vertical column, the flattened and dilated end of which is provided with long spines or processes (Pl. X. fig. 7). By reason of these closely placed spinous columns the surface of the perisome is rather rough. However, even in these specimens the greater part of the deposits of the body-wall is dissolved. Lately I have got four other specimens provided with twenty tentacles from

the same Station, 300, which are probably identical with the former; one of them, comparatively well preserved, has about thirteen processes along each dorsal ambulacrum, of which one pair, situated slightly in front of the middle of the body, has a length of 12 mm., while all the remaining ones are minute and wart-like. This specimen also is provided with the large diverticulum characteristic of the species in question.

It is very probable that some of the specimens, especially of those obtained at Station 298, which are referred to *Pælopatides confundens*, belong to another species, but it seems almost impossible to state this confidently, considering that in most of the specimens all deposits are destroyed. As to their outer shape, I cannot find any marked difference, if there even exist some small variations.

Pelopatides aspera, n. sp. (Pl. X. fig. 13).

Body depressed, oval, or of almost equal breadth throughout, more obtusely rounded anteriorly than posteriorly. Mouth completely ventral. Anus subdorsal. Tentacles twenty. A rather broad brim surrounds the body, in the margin of which a row of small prominences is situated. The anterior part of the brim, surrounding the anterior extremity of the body, is much thinner than the rest, and bears some resemblance to a large transverse lobe. The ventral odd ambulacrum with a few pairs of pedicels only in its posterior part. The two dorsal ambulacra with a few very minute, slender, retractile processes. Body-wall thick, soft and pliable, containing numerous four-armed bodies with the arms curved and spinous, and with a long spinous central column; these spines are minute, and arranged in transverse bands or rings. Colour in alcohol dark brownish-violet. Length in contracted state 125 mm., breadth 75 mm.

Habitat.—Station 207, January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; depth, 700 fathoms; bottom temperature, 51°·6; blue mud; a single individual.

The anterior thin lobe-like part of the brim, which constitutes the foremost portion of the body, does not seem to be in immediate continuation with the rest of the brim, which is formed by the very thick sides of the body; the margin itself of this latter brim, in which the small processes or prominences are found, is of course much thinner, and may strictly be considered as the true brim. The processes of the brim resemble small, low conical elevations, or, as is the case in the anterior lobe-like brim, more elongated narrow papillæ. Only the posterior third of the odd ambulacrum carries some small pedicels, seven in number, arranged in a double row; besides, two other pedicels are visible posteriorly on the left ventral interambulacrum. The dorsal ambulacral appendages seem to be few, very fine and thread-like, so that they are scarcely visible to the naked eye. So far as I can find, the number of tentacles is twenty, but some are less developed than the rest.

All the internal organs are destroyed excepting the respiratory trees, which seem to

be well developed. The longitudinal muscles each consist of two bands. The arms of the deposits of the body-wall (Pl. X. fig. 13) are more or less strongly curved inwards, and have a length of up to 0·3 mm.; their ends are slightly enlarged and spinous. The central, outwardly directed column has a length of about 0·24 mm. Both this column and the arms are remarkable in that the minute spines are mostly arranged in transverse bands or rings; thus I counted five such rings in the central column and five to six or more in the arms. Sometimes the spines seem to be more irregularly scattered. The pedicels are strengthened by the same kind of deposits, though they are smaller, and also by some small simple spicules; no terminal plates seem to be present.

(?) *Pælopatides appendiculata*, n. sp.

Station 235, June 4, 1875; lat. 34° 7′ N., long. 138° 0′ E.; depth, 565 fathoms; bottom temperature, 38°·1; green mud; three specimens.

Considering that all the three specimens brought home from the above-mentioned Station are rather macerated and defective, and that the calcareous ring and the deposits of the perisome are totally destroyed, I think it best to give a description without any previous diagnosis.

The largest and best preserved specimen measures in length about 200 mm. The body is elongated and cylindrical, equally rounded anteriorly and posteriorly. The mouth is almost terminal, though ventral in position. The anus is dorsal. Round the sides of the body, as well as round its anterior and posterior ends, the body-wall seems to be slightly thicker, but, as far as I can find, no true brim is discernible. Numerous closely placed conical and flexible processes run out from this thicker part of the body, and they are so arranged as to form a simple row round the body. The largest of these processes are about 10 or 15 mm. long. The dorsal surface also carries processes, but from the defective state of the specimens it is impossible to distinguish their size and distribution. However, they seem to be few in number, arranged only on the ambulacra in a simple row on each, and a pair of them, situated slightly in front of the middle of the body, is larger than the rest. A double row of pedicels is situated along the odd ventral ambulacrum, which appears to be naked only anteriorly. Thus all the interambulacra seem to be in want of ambulacral appendages. The tentacles are twenty, and consist of a small disk with about six digits or processes. The body-wall is very soft, spongy, thick, and swollen, probably from the influence of some acid in the alcohol. The colour in alcohol is sea-green, excepting along the middle of the ventral surface, where it is darkish brown, but probably the original colour is spoiled.

A single Polian vesicle is present, 35 to 40 mm. long. The reproductive organs consist of a bundle of tubes on each side of the dorsal mesentery, each genital tube being branched three to five times. The most anteriorly situated tubes, which constitute each

bundle, are comparatively small, while the posterior ones have a length of about 6 mm. The specimen examined being a female, the genital tubes are present in the shape of strings of pearls. The intestinal tube is spoiled, but a very well-developed respiratory-tree is left, which has the length of the body itself and is attached to the right dorsal interambulacrum by means of numerous threads. This tree consists of a wide tube and numerous bush-like branches. Probably the left tree has been thrown away together with the intestinal canal.

Genus *Stichopus*, Brandt, 1835.

Stichopus möbii, Semper, 1868 (Pl. IX. fig. 1).

Habitat.—Bermudas; one specimen.

The single specimen brought home by the Challenger Expedition is rather deformed and compressed; however, there seems to be but little doubt of its identity with the species of Semper. Length, 135 mm. Tentacles eighteen. The dorsal ambulacral appendages small, and scattered without order; those situated along the sides of the body seem to be slightly larger. The tentacles are withdrawn into the body, and the anterior aperture is surrounded by a crown of small papillæ.

In addition to the smaller tables (Pl. IX. fig. 1, *a*, *b*, *c*), measuring about 0·04 mm. in height, and provided with up to twenty teeth in the top of the spire, I have found some scattered larger ones (Pl. IX. fig. 1, *d*, *e*), which are not mentioned by Semper; probably they have escaped his attention. The differences between these two kinds of tables will be best understood from the figures. The smaller tables are more solid, and their disks measure about 0·04 mm. in diameter. The larger tables have a height of 0·06 mm. and about the same in diameter; their spire has a rounded and finely spinous top. The transverse rows of the pedicels (Pl. IX. fig. 1, *f*) have a length of 0·38 mm. The C-shaped (Pl. IX. fig. 1, *g*) bodies are often about 0·052 mm. long, but they vary much in size and shape.

Stichopus chloronotus, Brandt, 1835 (Pl. VII. fig. 6).

Habitat.—Tongatabu (Friendly Islands); a single specimen. Fiji Islands; five specimens.

Colour, olive-brown. Tentacles twenty. Mouth surrounded by a crown of papillæ. Dorsal ambulacral appendages in the shape of conical warts or protuberances distributed in a double alternating row along each side of the body as well as along the dorsal ambulacra; their arrangement in a double row is more distinct in the dorsal ambulacra than on the sides. The odd interambulacrum and those of the sides of the body are naked. The ventral pedicels are crowded, and their arrangement in longitudinal series

not very clear in the contracted and wrinkled specimens which I have had at my disposal. A single madreporic canal and three Polian vesicles present. Deposits—numerous C-shaped bodies (Pl. VII. fig. 6, *e*); tables (Pl. VII. fig. 6, *a*, *b*, *c*); besides, I have found a very few incomplete rosettes or dichotomously branched bodies (Pl. VII. fig. 6, *d*) which were absent in the typical specimens examined by Selenka and others. Concerning the shape of the deposits, I refer to the plates. The pedicels contain spinous rods which are mostly enlarged and perforated at their middle (Pl. VII. fig. 6, *g*). The dorsal appendages are also strengthened by numerous curved, simple or branched rods. The presence of the rosettes is the only difference from the typical forms; possibly they are peculiar to the forms from the above-mentioned stations—or they have escaped my predecessors through their scarcity.

Stichopus japonicus, Selenka, 1867 (?) (Pl. VII. fig. 3).

Habitat.—Japan, March 14, 1875; from pools; a single specimen.

The specimen does not quite agree with the descriptions of Selenka and von Marenzeller, but, nevertheless, I do not think it possible to refer it to any other species. The dorsal surface is dark reddish-brown, while the ventral surface is light. A simple row of seven to eight rather considerable conical prominences is situated along each side of the body, corresponding to the lateral ventral ambulacra, and another more irregular, double, or alternating row of equally large prominences is present along each dorsal ambulacrum. Small scattered papillæ are also to be found all over the dorsal surface. The ventral pedicels are much more crowded, but from the contracted condition of the perisome it is impossible to distinguish any arrangement of them in longitudinal series. From the inside of the body, on the contrary, it is easy enough to find a longitudinal space along the middle of the two ventral interambulacra free from pedicels. So far my observations seem to agree with those of Selenka and von Marenzeller. It is especially with regard to the deposits that disagreements exist, which render the correctness of my determination dubious.

The tables have the same shape as described by von Marenzeller (Pl. VII. fig. 3, *a*, *b*), but, besides these, I find a great quantity of small rounded or oval perforated plates (Pl. VII. fig. 3, *c*), some of which bear a certain resemblance to buttons. Selenka also described such bodies under the name of "Hemmungsbildungen." The pedicels possess, besides terminal plates, tables and the above named small plates, elongated button-like plates with two longitudinal rows of holes (Pl. VII. fig. 3, *d*); these plates, which have a length of about 0·15 mm. or more, are often somewhat deformed, rod-like. The papillæ, on the contrary, are characterised not only by such elongated plates, but also by curved spinous transverse rods (Pl. VII. fig. 3, *e*). Neither Selenka nor von Marenzeller mentioned anything about these deposits which I find in the dorsal papillæ.

Stichopus japonicus, var. *typicus*, nov. (Pl. VIII. fig. 2).

Habitat.—Japan, May 1875; two specimens.

The two specimens brought home by the Challenger Expedition have each a length of 220 mm., thus being much larger than the previously known forms described by Selenka and von Marenzeller. In consequence of the existence of some differences I prefer for the present to consider the Challenger specimens as a variety, though it is most probable that they represent the older and more fully developed forms of *Stichopus japonicus*, a supposition confirmed not only from the greater size, but also from the presence of well-developed genital bundles on each side of the dorsal mesentery; neither Selenka nor von Marenzeller found the reproductive organs developed.

The colour is reddish or brownish-grey, lighter on the ventral surface. The tops of the dorsal papillæ are light, in one individual almost whitish. Even the sucking-disks of the pedicels are light coloured. The largest processes attain a length of about 15 mm., and a breadth at the base of 8 mm. or more, and their arrangement agrees with that described by von Marenzeller. The small dorsal papillæ, scattered among the larger, seem to be rather numerous.

The rather long, slender genital tubes are several times branched, and form two bundles not very thick, one on each side of the dorsal mesentery. The Cuvierian organs seem to be absent. A single Polian vesicle and madreporic canal are present. The calcareous ring is peculiar not only in that the ventral interradial pieces are smaller than the dorsal, but especially in that the dorsal radial pieces (Pl. VIII. fig 2, *f*) are provided with rather considerable posterior prolongations, which, on the contrary, is not the case with the ventral radial pieces (Pl. VIII. fig. 2, *g*). Thus, when examining only the ventral part of the calcareous ring, one cannot get any exact idea of its true conformation. *Stichopus japonicus*, var. *typicus*, is not the only form that I have seen with such an asymmetrical calcareous ring.

The calcareous deposits consist of tables alone, but comparatively few of them are fully developed, by far the greater part presenting themselves under the shape of perforated disks with the margin very uneven or spinous, and with no spine or a very poorly developed one (Pl. VIII. fig. 2, *d*). The largest of these disks measure about 0·05 mm. in diameter. The rare complete tables are smaller and larger, composed of a rounded perforated disk with smooth margin and a spire built up of mostly four rods and one or more transverse beams (Pl. VIII. fig. 2, *a*, *b*, *c*). The spire often terminates in four longer or shorter teeth. The larger tables measure about 0·05 mm. in height, and their disks have a diameter of 0·05 mm. There are also to be found tables with a spire composed of only two rods. The dorsal papillæ are strengthened by numerous smooth or spinous, curved rods, and, besides, by elongated, bilateral, perforated, button-like plates with the holes arranged in two longitudinal rows (Pl. VIII. fig. 2, *e*). The pedicels are

almost destitute of such plates and rods, or provided with very few. I also found two or three smooth buttons with six holes, but these probably belong to another animal.

The specimens of *Stichopus japonicus* described as types seem to have the disks of the incomplete tables smooth.

Stichopus haytiensis, Semper, 1868 (?) (Pl. VII. fig. 5).

Habitat.—Bermuda; a single incomplete individual.

Having examined only a single specimen, which is very contracted and deformed, I cannot be fully certain of the exactness of my determination. The ventral pedicels are disposed in three longitudinal series; Semper mentions five such series. The arrangement of the dorsal ambulacral appendages is not fully known; I only find a row of larger conical prominences along each side of the body, but I must leave it undecided whether the remaining prominences (=papillæ) are disposed in rows or not. The tentacles are twenty, of unequal size. The colour is darkish chocolate-brown, lighter on the ventral surface. All the internal organs are spoiled, excepting the calcareous ring, which is peculiar in having its radial pieces bifurcated posteriorly; the respective pieces do not seem to be of equal size. The calcareous deposits consist of very thinly scattered **C**-shaped bodies, about 0·05 mm. long (Pl. VII. fig. 5, *f*), and very numerous crowded tables (Pl. VII. fig. 5, *a*, *b*, *c*), with the disk mostly pierced by a larger central hole surrounded by a ring of smaller holes; the margins of these disks are often more or less uneven, but never spinous. The spire of the tables has a single transverse beam, and terminates regularly in twelve teeth or spines; sometimes, however, the top of the spire is provided with more spines. The tables are about 0·044 mm. high. In the pedicels and dorsal processes the disks of the tables are often reduced to a simple calcareous ring, combining the bases of the four rods which constitute the spire (Pl. VII. fig. 5, *d*). The ventral as well as dorsal ambulacral appendages are strengthened by numerous transverse, simple, or branched irregular rods. Semper does not mention anything about the characteristic shape of the calcareous ring (Pl. VII. fig. 5, *e*) which is present in the animal brought home from Bermuda, wherefore it is possible that this form, on account of this peculiarity, represents a new variety.

Stichopus variegatus, Semper, 1868 (Pl. VII. fig. 7).

Habitat.—Zebu Reefs (Philippine Islands); a single specimen.

The very contracted and deformed individual is doubtless a young form, its length in the contracted state being only about 120 mm. The colour is yellowish-grey inclining to brownish, lighter on the ventral surface. There are twenty yellowish tentacles. The pedicels are disposed in three distinct series, the two lateral composed of

two or three rows, the middle one of five or six. The dorsal papillæ are small and fully retracted, and therefore their true disposition is not discernible in the very contracted and wrinkled specimen. A single madreporic canal and Polian vesicle are present. The calcareous ring is like that figured by Semper. The forms of the deposits are shown in the figures, and seem to agree with those of Semper. The C-shaped bodies (Pl. VII. fig. 7, *e*) are numerous and of very unequal size, some being small, others large; usually their length reaches as much as 0·06 mm. The rosettes or dichotomously branched bodies (Pl. VII. fig. 7, *d*) are small, measuring about 0·3 mm., and the tables (Pl. VII. figs. 7, *a*, *b*, *c*) have a height of about 0·032 mm. The pedicels are strengthened by spinous rods (Pl. VII. fig. 7, *f*), commonly enlarged and perforated at the middle, and even the papillæ are provided with numerous crowded, slightly curved, spinous rods.

Stichopus challengeri, n. sp. (Pl. X. fig. 21).

Body elongated, cylindrical, more tapered posteriorly than anteriorly, slightly flattened. Mouth ventral, surrounded by nineteen tentacles. Anus terminal. Ventral surface with three longitudinal series of cylindrical pedicels, the two lateral series composed of two rows, the middle broader one of two to four rows. Dorsal surface with elongated, conical processes scattered over the ambulacra and interambulacra; an arrangement of them in rows is scarcely to be found elsewhere than along the sides of the body, where they evidently belong to the lateral ventral ambulacra. Body-wall thin and pliable, with scattered deposits, composed of three to four arms and a central column terminating in a few small teeth; the arms are mostly bifurcate at the ends, but sometimes perforated. As a rule, the deposits are not very symmetrical. The pedicels and processes are supported by numerous spinous, slightly curved rods, and the former bear a well-developed terminal plate. Colour in alcohol, grey inclining to violet; tentacles yellowish. Length, 160 mm. or more.

Habitat.—Station 148A, January 3, 1874; lat. 46° 53′ S., long. 51° 52′ E.; depth, 550 fathoms; hard ground, gravel, shells; a single slightly macerated specimen.

The dorsal processes have a length of about 7 mm.; the largest are to be found round the anterior extremity of the body. Excepting four-armed bodies like those in the body-wall itself, but considerably larger and with the enlarged ends of the arms perforated, the processes contain numerous simple, or, more seldom, branched spinous spicules, which often have the ends perforated by a small hole. The top of the processes is supported by small irregularly branched and spinous spicules forming a kind of terminal plate. The cylindrical, wide pedicels, about 5 mm. long, form an alternating double row along each side of the ventral surface, and, also, a median series, composed, apparently, of about four rows of pedicels on the posterior half of

the body; anteriorly, the odd ambulacrum carries only two rows of pedicels. The pedicels have a well-developed terminal plate, numerous spinous, curved rods, often with the ends perforated, and, besides, a number of four- or three-armed deposits. The form of the deposits of the body-wall (Pl. X. fig. 21) will be best understood from the figures; their diameter is about 0·056 mm., while the central column has a length of about 0·08 mm. In the dorsal processes the deposits often attain a diameter of about 0·28 mm. The central column mostly terminates in three or four short tops, and it is often, especially in the dorsal processes, pierced with one or two holes near the free end; a true "spire" is never to be found. I have observed two C-shaped deposits, but they probably belong to another animal.

The calcareous ring is well developed, of the usual shape, without posterior prolongations. Two Polian vesicles are present, of which one has a length of 25 mm., while the other is rudimentary. The single dorsal madreporic canal is attached to the dorsal mesentery. A bundle of very long, slender genital tubes, two or three times dichotomously branched, is situated on each side of the dorsal mesentery. A single respiratory tree with two branches is present, and does not seem to have any intimate connection with the pseudhæmal vessels.

Stichopus (?) torvus, n. sp. (Pl. X. figs. 2–4)

Body cylindrical, with the ventral surface considerably more flattened than the strongly convex dorsal surface; along the line of junction of the two surfaces the body-wall is slightly thickened. Mouth and anus almost terminal, slightly ventral in position. Tentacles twenty. The dorsal surface and the lateral parts of the ventral surface covered with conical processes, of which those forming a row along the transition between the upper and lower surfaces of the body attain a more considerable size and often bear branches; the processes decrease slightly in size towards the middle of the back. The rest of the ventral surface is covered with small crowded ambulacral appendages, the form and shape of which are unknown. Calcareous deposits totally absent, probably dissolved (?). Colour in alcohol, dirty brown, speckled with lighter spots on the back; tentacles, mouth, and a space round the mouth almost black. Length about 210 mm.

Habitat.—Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; depth, 1375 fathoms; bottom temperature, 35°·5; Globigerina ooze; a single specimen.

The individual I have had at my disposal is so much macerated, wrinkled, and covered with foreign matters as to make a detailed examination impossible. Some impurity in the alcohol has also probably dissolved the calcareous substances in the perisome, in consequence of which it is impossible to state the true shape of the ventral ambulacral appendages; they were either true cylindrical pedicels provided with sucking-

disks and terminal plates, or they are to be referred to papillæ. They resemble small rounded warts, which, to judge from the ampullæ visible on the inside of the body-wall, are very crowded and form a broad series along the middle of the ventral surface. Even the processes, which are to be found on the rest of the body, have such ampullæ, and these are larger when they communicate with the larger processes along the sides of the body. The largest processes, which attain a length of about 20 mm., are mostly of very great dimensions at the base, and terminate in two to four processes, thus presenting the aspect of being branched (Pl. X. fig. 3). The rounded terminal disk of the tentacles carries as many as twelve small processes in its margin.

The calcareous ring (Pl. X. fig. 2) is strongly developed, without posterior prolongations. A single ventral Polian vesicle, 40 mm. long, is present. Madreporic canal unknown. The reproductive organs form a close bundle on each side of the dorsal mesentery, each bundle being composed of a number of short, slightly branched, oval sacs or tubes (Pl. X. fig. 4). The longitudinal muscular bands seem to be simple, though their middle parts do not attain any considerable thickness. The right respiratory tree alone is developed.

The external appearance as well as the internal organisation remind one of a *Stichopus*, and therefore I prefer for the present to refer the above described species to that genus. There exist, however, such important differences in the shape and arrangement of the ventral ambulacral appendages that one might be fully justified in considering it a type of a new genus; but, considering that the specimen at my disposal is rather deformed, so that a part of the ventral ambulacral appendages are indistinguishable, and that all the deposits are spoiled, I think it best to leave that to the future.

Stichopus moseleyi, n. sp. (Pl. X. figs. 19, 20).

Body elongated, almost cylindrical, probably slightly flattened on the ventral surface. Mouth bent toward the ventral surface; anus almost terminal. Ventral surface with three series of pedicels, the middle one forming a thin double row, the two lateral a simple zigzag row. Each of the two dorsal ambulacra with a narrow double row of small conical papillæ. The two dorsal interambulacra carry a number of low whitish warts; the ventral surface also contains such warts though more sparingly. A crown of small papillæ surrounds the mouth. Tentacles about seventeen (?). Body-wall thin and pliable, supported by tables of a characteristic form; the disks are cross- or star-like, with from four to eight arms radiating from a common centre, and with the ends of the arms enlarged, flattened, and pierced with holes; sometimes the enlarged ends of some or all of the arms are connected with one another, thus constituting a perforated plate; the spire is composed of four rods, and one, seldom two, transverse beams; the spire is often devoid of transverse beams. The top of the spire is irregularly

spinous, often with four larger teeth. Colour in alcohol, whitish, inclining to violet or rose. Length of the largest specimen, 140 to 150 mm.

Habitat.—Station 306A, January 2, 1876; lat. 48° 27′ S., long. 74° 30′ W.; depth, 345 fathoms; bottom temperature, 46°·0; blue mud; four specimens. Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ W.; depth, 175 fathoms; blue mud; two specimens. Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ W.; depth, 245 fathoms; bottom temperature, 46°·0; blue mud; several specimens.

When the animal is fully extended, the body-wall does not seem to present any particular thickness along the sides of the body. The dorsal papillæ, which are placed in a narrow double row only on the dorsal ambulacra, are narrow, elongated, conical, and up to 5 mm. long. This arrangement in double rows is far more distinct in the specimens obtained at Station 311. The position of the pedicels is also more easy to distinguish in the specimens just mentioned. When the body is contracted, the three series of pedicels seem to be considerably broader. The slightly darker sucking-disks measure about 1 mm. in diameter. The warts, which are present on the two lateral dorsal interambulacra as well as on the ventral surface, do not form any rows; they are low, of a whitish colour, and mostly attain a greater diameter than the sucking-disks of the pedicels; at first sight one is tempted to consider them as disks of large retracted pedicels, but a closer examination shows the falsity of this supposition. The pedicels are strengthened by a large perforated terminal plate, surrounded by a few small, oblong, perforated, irregular plates and spinous, slightly curved rods. The pedicels also contain numerous tables in a more or less deformed state. The warts bear some tables near their base, but I cannot find any other deposits in them; they resemble large, flattened disks of pedicels without supporting rods and terminal plates. The papillæ bear at their top a very rudimentary terminal plate, consisting of an irregularly branched network, surrounded by a few transverse slightly spinous rods; crowded tables fill up the rest of the integument of the papillæ. The exact number of tentacles is not fully stated; in one individual I counted seventeen. The retractor muscles are, of course, absent, and the longitudinal muscular bands simple.

The shape of the deposits will be best understood from the figures (Pl. X. figs. 19, 20). The diameter of the disk is about 0·17 mm., and the length of the spire 0·064 mm. The spire, especially in the pedicels and papillæ, often terminates in four teeth, and the complete though irregularly perforated disks are also more frequent in these positions.

The animals seem to lack the calcareous ring. A single Polian vesicle, 16 mm. long, is present. The dorsal madreporic canal is attached to the dorsal mesentery. A bundle of slender, slightly branched genital tubes is situated on each side of the dorsal mesentery. Two respiratory trees run out from a common base, and neither of them has any more intimate connection with the pseudhæmal vessel system.

In one of the more complete specimens obtained at Station 311, I have observed some

small conical papillæ also on the sides of the body above the lateral ventral pedicels. The colour is also somewhat different, the specimens mentioned being light greyish inclining to brown.

The species here described is evidently nearly allied to *Stichopus natans*, Sars, and *Stichopus tizardi*, Théel.

Stichopus sordidus, n. sp. (Pl. VIII. fig. 3).

Tentacles twenty. The ventral pedicels not very obviously arranged in three series, the middle one broader than the lateral. A simple row of rather large conical processes present along each side of the body. Also larger and smaller processes or papillæ on the dorsal ambulacra, and some smaller ones spread over the interambulacra. Processes or papillæ not crowded, excepting round the mouth, where they form a crown. Deposits—tables alone, composed of a rounded or quadrangular, perforated disk with smooth margin and a spire of four rods and a single transverse beam. Spire of the tables terminating in about sixteen teeth. Dorsal papilla strengthened by numerous, curved, smooth, or slightly spinous rods; pedicels supported by a few rather large, irregularly bilateral, perforated plates. Colour in alcohol, dark brown, almost black, inclining to violet. Length in contracted state, 80 to 90 mm.

Habitat.—Station 167A, June 27, 1874; lat. 41° 4′ S., long. 174° 19′ E.; Queen Charlotte Sound, near Long Island (New Zealand); depth, 10 fathoms; mud; eight very contracted specimens.

All the specimens are very contracted and wrinkled, their true shape and size being unrecognisable. For the same reason, the position of the dorsal ambulacral appendages is not fully clear. Excepting the simple row of conical large prominences along each side of the body, which is always well defined, there seems generally to be an alternating row of equally large processes along each dorsal ambulacrum, and, besides, some smaller papillæ scattered not only on the ambulacra, but also on the interambulacra, where, however, they seem to be very rare. Consequently it appears that the processes and papillæ are principally collected on the two dorsal ambulacra as well as along the sides of the body. The larger processes have a length of about 8 mm. and a breadth at the base of 5 or 6 mm.

The calcareous ring is of the usual form, the radial pieces considerably larger, almost quadrangular and slightly incised posteriorly. A single madreporic canal and Polian vesicle are present. All the individuals have lost their viscera, excepting one which has a thin bundle of long, very narrow and slender genital tubes, several times branched, on each side of the dorsal mesentery.

Only one kind of deposit seems to be present, viz., tables (Pl. VIII. fig. 3, *a*, *b*, *c*); but it must be noted that I have also found a few oval buttons of the well known form with

six holes, though there seems to be but little doubt, that these belong to another animal and have adhered to the skin of the individuals examined by me. The diameter of the disks is about 0·05 mm., and the spire attains a height of about 0·04 mm. The fenestrated, irregularly bilateral plates (Pl. VIII. fig. 3, *d*) of the pedicels are rather large. So far as I can find out, this form brought home by the Challenger Expedition cannot be referred to any previously known species, though it doubtless bears some resemblance in external organisation to *Stichopus armatus*, Selenka, and *Stichopus japonica*, Selenka.

Stichopus godeffroyi, var. *b*, Semper, 1868 (Pl. VII. fig. 8).

Habitat.—Sandwich Islands; a single individual.

The only specimen at my disposal being very wrinkled, deformed, and covered with sea-weed, I cannot determine how the dorsal ambulacral appendages are arranged. A simple row of conical protuberances is easily enough distinguished along each side of the body, but I am by no means sure of the arrangement of the remaining dorsal appendages. However, I think I have observed some protuberances on the dorsal ambulacra, and, also, some small scattered papillæ on the interambulacra. The colour is yellowish-grey inclining to brown, lighter on the ventral surface. Two Polian vesicles and a single dorsal madreporic canal are present. The calcareous ring is like that in *Stichopus horrens*, Selenka; the radial pieces have four tops anteriorly, and the interradial a single one. Deposits—large tables (Pl. VII. fig. 8, *f*, *g*) with the spire terminating in a single conical top; large and small tables with the spire terminating in several teeth (Pl. VII. fig. 8, *a*, *b*, *c*); C-shaped bodies (Pl. VII. fig. 8, *e*); and dichotomously branched bodies (Pl. VII. fig. 8, *d*). The large tables seem to be present only in the dorsal perisome, have a height of 0·12 mm. to 0·14 mm., and their large irregularly rounded disks are pierced by numerous holes and have a diameter of about 0·12 mm. The small tables are present all over the body, and measure about 0·04 mm. in height; their spire terminates in about twelve teeth, and their disks are either rounded or angular. Besides these tables, one finds in the dorsal body-wall other tables of the same appearance but of much greater dimensions, their height being about 0·08 mm. and the diameter of their disks measuring as much as 0·072 mm. The C-shaped bodies have a length of about 0·14 mm., but those on the ventral surface seem to be smaller. The dichotomously branched bodies or rosettes are small, about 0·036 mm. in length. The pedicels as well as the dorsal ambulacral appendages are strengthened by strong, slightly curved rods, of which those in the former are usually dilated at the middle and perforated, while the dorsal rods, more curved, only have some finely spinous branches at the middle, which are sometimes united so as to form a single or a few holes.

The species is doubtless very nearly allied to *Stichopus horrens*, and if it can be shown that the Challenger specimen has the dorsal appendages in rows on the ambulacra only, it may be referred to that species.

Genus *Pseudostichopus*, n. gen.

Tentacles nineteen or twenty. Ambulacral appendages in the shape of pedicels alone (?); those on the ventral surface not arranged in the three longitudinal series characteristic of *Stichopus*. Two bundles of genital tubes present. Anus without teeth, but hidden in a distinct vertical furrow. Deposits unknown. Rectractors absent.

Pseudostichopus mollis, n. sp. (Pl. X. figs. 5, 6).

Body more or less elongately oval, equally rounded anteriorly and posteriorly. Mouth almost completely ventral in position. Tentacles twenty. Anus ventral, hidden in a rather deep furrow formed by two vertical folds of the perisome. Pedicels very minute, present only on the paired ambulacra; the odd ventral ambulacrum seems to be naked, if pedicels really exist, they must be very rudimentary. Pedicels of the dorsal surface arranged in a narrow double row along each ambulacrum, those of the lateral ventral ambulacra being more crowded and, as it seems, placed in two to five (?) rows. Calcareous deposits of the perisome absent. Colour in alcohol, light yellowish-white. Length, 140 mm.

Habitat.—Station 309A, January 8, 1876; lat. 50° 56′ S., long. 74° 14′ W.; depth, 140 fathoms; blue mud; six specimens. Station 311, January 11, 1876; lat. 52° 45° 30′ S., long. 73° 46′ W.; depth, 245 fathoms; bottom temperature, 46°·0; blue mud; numerous specimens. Station 144A, off Marion Island, December 26, 1873; lat. 46° 48′ S., long. 37° 49′ 30″ E.; depth, 50 to 75 fathoms; bottom, volcanic sand; two specimens.

Though I cannot find any deposits in the perisome, it seems very likely that such were present in the living animals, and, consequently, that they have been dissolved in the Challenger specimens by the influence of some acid. From the want of deposits as well as from the minuteness of the pedicels in general, a very careful examination is necessary to be convinced of the presence of these pedicels, which are almost indistinguishable from the exterior of the body. At first sight therefore one is tempted to consider the animals as belonging to the apodous Holothurids. For the same reasons I cannot positively state the absence of pedicels in the odd ambulacrum; sometimes I thought I observed some rudimentary ones. It is also almost impossible to tell the true shape of the ambulacral appendages, but, to judge from some small ones which I saw extended, they are probably pedicels and not papillæ. The vertical furrow in the posterior extremity of the body appears to be characteristic of the forms of this genus (Pl. X. fig. 5). The tentacles are retracted within the body and their processes retracted, but, as far as I can see, they must be allied to those present in the Aspidochirotæ.

The body-wall is soft, thin, and pliable; along the sides of the animals it is inconspicu-

ously thicker. The calcareous ring (Pl. X. fig. 6) is well developed, but in want of posterior prolongations. A single ventral Polian vesicle is present. The madreporic canal must be very inconsiderable, because I did not detect it in the three specimens examined by me. A bundle of rather long, slender unbranched genital tubes is situated on each side of the dorsal mesentery, and the long wide efferent duct opens on a small papilla, placed anteriorly on the dorsal surface. The longitudinal muscular bands are simple and not divided into two bands. Two well-developed respiratory-trees are present, running out from a common base, and neither of them seem to be in communication with the plexus of pseudhæmal vessels, though the left tree is embraced and held in a proper position by some larger "connecting branches" of vessels.

Since the above description was written I have received the two individuals dredged at Marion Islands. They agree closely with the specimens obtained from the other Stations, and the only difference of importance seems to be with regard to the tentacles, which in one of the examples from Marion Island are nineteen in number, but this must evidently be considered as a variation. In these two specimens, also, no pedicels are distinguishable in the odd ventral ambulacrum. With regard to the ventral lateral ambulacral appendages I am very dubious whether they be papillæ or pedicels. In one of the specimens they obviously resemble papillæ. The dorsal ambulacral appendages, on the contrary, bear a greater similarity to pedicels. The arrangement of the ventral lateral appendages, whether placed in two rows or more, is not clear. The deposits are totally dissolved, excepting in the dorsal pedicels, in which I have seen some fragments of spicules. The surface of the skin is covered with small Ascidians, Sponges, Bryozoa, &c., which have grown on it.

Pseudostichopus villosus, n. sp.

Body oval or elongated, equally rounded anteriorly and posteriorly. Mouth turned toward the ventral surface. Anus terminal, ventral, hidden in a rather deep furrow formed by two vertical folds of the body-wall. Tentacles nineteen or twenty, with numerous, crowded minute papillæ on the dilated terminal parts. Pedicels numerous, cylindrical and minute, often almost imperceptible, especially crowded along the sides of the body. Perisome soft and pliable, without calcareous deposits. Colour, lighter or darker brownish. Length up to 150 mm.

Habitat.—Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; depth, 1375 fathoms; bottom temperature, 35°·6 C.; Globigerina ooze; one incomplete specimen. Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom temperature, 34°·2; Diatom ooze; one specimen. Station 156, February 26, 1874; lat. 62° 26′ S., long. 95° 44′ E.; depth, 1975 fathoms; Diatom ooze; one individual. Station 157, March 3, 1874; lat. 53° 55′ S.;

long. 108° 35′ E.; depth, 1950 fathoms; bottom temperature, 32°·1; Diatom ooze; one individual. Station 302, December 28, 1875; lat. 42° 43′ S., long. 82° 11′ W.; depth, 1450 fathoms; bottom temperature, 35°·6; Globigerina ooze; fragments of an individual. Station 325, March 2, 1876; lat. 36° 44′ S., long. 46° 16′ W.; depth, 2650 fathoms; bottom temperature, 32°·7; blue mud. Station 244, June 28, 1875; lat. 35° 22′ N., long. 169° 53′ E.; depth, 2900 fathoms; bottom temperature, 35°·3; red clay; one specimen. Station 216A, February 16, 1875; lat. 2° 56′ N., long. 134° 11′ E.; depth, 2000 fathoms; bottom temperature, 35°·4; Globigerina ooze; one individual. Station 296, November 9, 1875; lat. 38° 6′ S., long. 88° 2′ W.; depth, 1825 fathoms; bottom temperature, 35°·3; Globigerina ooze; one individual. Station 61, June 17, 1873; lat. 34° 54′ N., long. 56° 38′ W.; depth, 2850 fathoms; bottom temperature, 36°·2; red mud; two specimens.

The only difference between this species and the preceding one is, so far as I know, that it has much more numerous and crowded pedicels, and that these seem to be smaller. For the rest, it closely resembles the preceding species in internal and external organisation.

In the specimen dredged at Station 244 the pedicels are very numerous and fully extended, in consequence of which the ventral surface, and especially the sides of the body, present a villous aspect. The ventral surface and the sides are dirty brown, while the rest of the body is grey. The pedicels are brownish. The posterior vertical furrow, in which the anus is situated, is not very distinct in the species in question. As is the case in the other representatives of this species, the two branches of the respiratory-tree run out from a common base.

The individual obtained at Station 216 is remarkable in that the pedicels of the dorsal surface and the sides of the body are slightly thicker and larger than those of the ventral surface, which are thread-like and very minute. Here, also, no deposits are visible. The Challenger Expedition also brought home from Station 61 two specimens, which must probably be referred to this species, though they differ from the preceding forms in having in the ventral perisome a part of the deposits left, though in a state of dissolution. These deposits are very peculiar, resembling rounded, flattened mulberries composed of numerous small irregular corpuscles. Several such deposits are aggregated here and there within the perisome. These deposits are probably much deformed by the influence of some acid. In the specimen from Station 244 I have seen some remains of deposits which must have had the shape of perforated plates. In the dorsal perisome, on the contrary, I cannot find any deposits at all. The brownish pedicels do not seem to be so numerous as in several of the preceding forms.

Pseudostichopus villosus, var. *violaceus*, nov. (Pl. X. fig. 6*b*).

Habitat. Station 156, February 26, 1874; lat. 62° 26′ S., long. 95° 44′ E.; depth, 1975 fathoms; Diatom ooze; one specimen.

This variety is distinguished by its dark violet colour. No other characters distinguishing it from the main forms have been observed. The tentacles are twenty in number. The vertical furrow, in which the downwardly directed anus is situated, is very distinct. The minute pedicels are numerous and distributed all over the body, and therefore also over the ventral surface, the foremost part of which, however, seems to be almost naked. Nor processes nor papillæ are visible. Length of the specimen about 170 mm. The body is oblong and more tapering posteriorly. Mouth ventral in position. The intestinal canal is of a dark violet colour. The calcareous ring (Pl. X. fig. 6*b*) has a somewhat different form, which, however, probably depends upon the degree of contraction. The slightly branched genital tubes have a considerable width, and are, like those in the main forms, collected into two thick bundles, one at each side of the dorsal mesentery. The two respiratory-trees run out from a common base.

Genus *Holothuria*, Linné, 1758.

Holothuria monacaria, Lesson, 1830 (Pl. VIII. fig. 10).

Habitat.—Fiji Islands; two specimens. Ternate (Molucca Islands); one individual.

Owing to the animals being highly contracted and wrinkled, their true size and shape are very difficult to distinguish. However, the body seems to be more or less markedly cylindrical, tapering equally towards each extremity. The length of the largest specimen is about 100 mm. The tentacles are twenty in number, and retracted within the body. The mouth is surrounded by a crown of small papillæ. The anus also carries some small, more irregularly disposed papillæ. The ventral pedicels seem to be more numerous than the dorsal papillæ. Both kinds of ambulacral appendages seem to reach about the same size, though the papillæ are broader at the base. When fully extended they attain a length of about 4 mm. or slightly more. In consequence of the papillæ being mostly completely retracted, it is not easy to distinguish their conical form from the cylindrical one which characterises the pedicels. But a few papillæ, being extended, evidently show that they are true papillæ. The sucking-disks of the papillæ are minute in comparison with those of the pedicels, and there also exists, of course, a great difference in size between the respective terminal plates. Owing to the contracted and wrinkled state, the arrangement of the pedicels in three longitudinal series is not very clear. Probably for the same reason, the dorsal papillæ do not present any distinct arrangement in longitudinal rows.

Colour in alcohol—ventral surface light yellowish-grey; dorsal surface darkish brown, inclining to greenish, excepting the papillæ and a space round their base which are yellowish-white. When the animal is wrinkled and contracted the dorsal surface gives the impression of being transversely streaked with brown and yellowish-white.

The calcareous ring is of the usual shape without posterior prolongations. Two ventral Polian vesicles are present, one of which measures about 100 mm. in length. A single dorsal madreporic canal is present. The genital organs are destroyed.

The deposits bear the closest resemblance to those in *Holothuria pardalis*, Selenka, &c., but the tables are devoid of spines on the disks, and the buttons are more uniformly crowded beneath the former all over the body. The numerous tables (Pl. VIII. fig. 10, *a*, *b*, *c*) have the disk small and smooth, and the spire composed of four rods united by a single transverse beam. The spire terminates in about eight or more teeth. The tables are about 0·048 mm. high, and their disks measure up to 0·056 mm. in diameter. The buttons (Pl. VIII. fig. 10, *d*), which are usually pierced by six holes, vary slightly in size, but the larger ones have a length of 0·068 mm. In the pedicels and papillæ the buttons often grow slightly larger, and are sometimes pierced by more than six holes. The pedicels bear near their ends irregularly rounded, perforated plates or even more elongated rod-like ones, which are of a more or less marked bilateral shape (Pl. VIII. fig. 10, *e*). Besides larger spinous or perforated, irregular rods resembling those in the pedicels, the papillæ carry small, more or less curved, simple or branched, spinous rods (Pl. VIII. fig. 10, *f*, *g*); the small supporting rods of the papillæ measure only 0·05 mm. in length, while the larger ones are 0·2 mm. long.

Holothuria minax, n. sp. (Pl. VIII. fig. 8).

Body elongated, slightly flattened on the ventral surface and furrowed along its middle. Tentacles eighteen. Anus roundish. Ventral surface with pedicels. Dorsal surface with small conical papillæ, a number of those situated along the sides of the body and in the neighbourhood of the dorsal ambulacra being placed on low warts with a broad base. The papillæ at the mouth and anus are slightly larger. Deposits of two kinds—tables with the rounded disk perforated by a central large opening and a series of smaller peripheral holes, and bearing a short spire composed of four rods and one transverse beam, and terminating in about twenty teeth or spines; and oval, regular or asymmetrical smooth buttons with six to ten (or more) holes. Pedicels strengthened by more or less symmetrically bilateral, perforated rods. Papillæ with perforated rods commonly of a more irregular shape. Colour in alcohol, light yellowish-brown; the ventral surface and the warts lighter. Length in contracted state about 160 mm., but probably much greater when the body is fully extended.

Habitat.—Japan; depth, 8 to 14 fathoms; one specimen.

Like many other Holothurians kept in alcohol, the body is very much contracted and wrinkled, its true size and shape being almost impossible to discern. For this reason I cannot state whether the pedicels are arranged in three longitudinal series or distributed without order. Even the position of the dorsal warts and papillæ is not fully known, though I have observed that the warts which carry papillæ are situated mainly on or in the neighbourhood of the dorsal ambulacra as well as on the sides of the body. Numerous papillæ are situated between the warts on the ambulacra as well as inter-ambulacra. The warts are always very low though with a broad base. The calcareous ring is of the usual form, almost like that in *Holothuria decorata*, von Marenzeller. A single Polian vesicle, 27 mm. long, is present. On the left side of the dorsal mesentery is a single madreporic canal, on the right side three, all with the free ends enlarged and pear-shaped.

The tables (Pl. VIII. fig. 8, *a*, *b*) as well as the buttons (Pl. VIII. fig. 8, *c*) closely resemble those in the above-named species described by von Marenzeller, but I never found more than one transverse beam in the spire of the tables, while *Holothuria decorata* has tables partly with a shorter spire and one transverse beam and partly with a larger spire and as many as three beams. The disks of the tables, which measure about 0·08 mm. in diameter, usually possess a simple series of holes surrounding the central large hole, and I only once observed a disk with more holes round the margin. The buttons sometimes present themselves under a more unusual shape as will be seen from the figures; the larger ones have a length of 0·1 mm. The pedicels carry, besides the perforated rods (Pl. VIII. fig. 8, *d*), more or less completely developed tables and buttons.

There is no doubt that the animal in question is related to *Holothuria decorata* as well as to *Holothuria monacaria*, Lesson, and, though I cannot be sure of the position of the pedicels and processes, it probably belongs to *Stichopodes* of Semper.

Holothuria africana, n. sp. (Pl. VIII. fig. 7).

Body cylindrical, equally rounded at each extremity or slightly more tapering posteriorly. Mouth closed and ventral in position. Tentacles twenty (?), completely withdrawn into the body. Anus rounded. Ambulacral appendages minute, scattered without order all over the body, the dorsal ones slightly smaller than the ventral, and presenting themselves, as it seems, under two different forms, some being more conical, papilla-like and without any very marked sucking-disk, others, on the contrary, having a cylindrical form with a more distinct sucking-disk and approaching true pedicels in general appearance. All the ventral ambulacral appendages are true pedicels with well-defined sucking-disks, and seem to be slightly more crowded. Body-wall very thick and inflexible, probably the result of strong contraction in alcohol. Deposits of two kinds—tables and

plates. The tables have the perforated disk smooth, undulating, or provided with spines in the margin, and their spire, composed of four rods and one transverse beam, terminates in twelve teeth. The plates, much more numerous than the tables, and crowded in heaps, are commonly rounded, flat and disk-like, with the margin slightly uneven, and perforated by more or less numerous minute holes; among these other more or less irregularly rectangular plates with fewer but larger holes are to be found. The dorsal conical appendages are alone furnished with transverse supporting rods near the more or less incompletely developed terminal plates; the rest of the dorsal appendages as well as the ventral pedicels seem to be devoid of any rods or plates, or only have a few irregular plates round the terminal plate which is always well developed. Colour in alcohol, dark greyish-brown on the back and the sides, and light almost whitish-grey on the ventral surface; the ventral pedicels brownish. Length about 190 mm.

Habitat.—Simon's Bay; depth, 10 to 20 fathoms; a single specimen.

This species is remarkable in possessing, besides true minute dorsal pedicels, minute dorsal papillæ which differ from the former not only in their exterior form, but especially in the presence of simple or slightly branched, strong rods. It seems as if the dorsal papillæ are less numerous than the dorsal pedicels.

The calcareous ring seems to be of the usual shape without posterior prolongations. The Polian vesicles are numerous, up to twelve or more, of unequal size, and some of them carry small branches at their base. A bundle of from five to sixteen madreporic canals with pear-shaped ends is situated on each side of the dorsal mesentery. The reproductive organs consist of a bundle of tubes, several times branched, situated on the left side of the dorsal mesentery. The respiratory-trees are well developed.

The tables (Pl. VIII. fig. 7, *a*, *b*, *c*), when fully developed, have a simple circle of holes round the margin of the disk which attains a diameter of about 0·056 mm.; their spire is about 0·04 mm. high. Most of the disks are smooth, but I have often seen them with spines. In the pedicels, the disks of the tables are absent or reduced to a simple ring. The rounded flat plates, about 0·03 mm. in diameter (Pl. VIII. fig. 7, *e*), are characterised by their minute holes, and they seem to be collected into heaps in some parts of the body. The other plates (Pl. VIII. fig. 7, *d*), which attain about the same size as the former, have a more irregular form, but they often present themselves under the shape of a more or less irregular rectangle; they have some resemblance to disks of the tables, and their surfaces are not always quite even. The species in question is possibly identical with Ludwig's *Holothuria mexicana*.

Holothuria spinifera, n. sp. (Pl. VIII. fig. 1).

Body cylindrical, equally rounded anteriorly and posteriorly. The closed mouth surrounded by a collar of small papillæ. Tentacles twenty (?). Anus with five groups

of small, very spinous cylindrical papillæ, thus stellate in appearance. Ambulacral appendages—papillæ, rather closely placed all over the body, without any arrangement in rows. Deposits—tables with rounded, somewhat irregularly perforated disk and a short spire, built up of four rods and one transverse beam, and terminating in a rounded very spinous top; knobbed buttons, mostly with six holes and very often with irregular beams joining the tops of several knobs. Besides numerous perforated transverse rods, the papillæ possess tables near their ends which have the disk perforated by numerous holes and the spire drawn out into a very long simple point, communicating to the papillæ a very rough and spinous aspect. Colour in alcohol—ventral surface whitish inclining to yellowish, with some large light brownish spots at the middle; dorsal surface light brown inclining to yellowish on the sides, and with some larger darker spots at the middle. Length about 240 mm.

Habitat.—Station 208, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; blue mud; one specimen.

This species is doubtless nearly allied to Semper's *Holothuria aculeata*, but Semper does not mention anything about the characteristic tables in the papillæ, and therefore I must suppose that *Holothuria aculeata* is devoid of them. Some other differences exist which will be stated further on.

To judge from the single contracted specimen I have at my disposal, the conical papillæ along the sides of the body are slightly larger than the rest, and the sides themselves slightly thickened. Besides, the dorsal papillæ seem generally to be more conical than those of the ventral surface, which are like rounded warts. Especially the dorsal papillæ and the papillæ round the anus are obviously spinous to the naked eye, owing to the long spire of the tables. Owing to the groups of papillæ, the anus acquires a stellate aspect.

The calcareous ring is of the usual shape without posterior prolongations. The Polian vesicle has a length of 35 mm. The madreporic canal is uncommonly large and thick, attaining a length of about 40 mm. or more; it contains a network of very fine calcareous threads. A thick bundle of long, genital tubes, branched three to four times, is situated on the left side of the dorsal mesentery. The respiratory-trees are very well developed and branched.

The calcareous tables (Pl. VIII. fig. 1, *a*, *b*) attain a height of about 0·1 mm., and their disks are commonly convex on the inner surface; the buttons (Pl. VIII. fig. 1, *e*, *f*), are about 0·05 mm. long, and their central knobs are generally larger than the peripheral ones. The buttons often have a very asymmetrical appearance owing to the beams which join the tops of the knobs. The characteristic tables of the papillæ (Pl. VIII. fig. 1, *c*, *d*) have a large, irregular disk with numerous holes, and measuring as much as 0·14 mm. in diameter; and their spire, attaining a length of 0·36 mm., is built up of four rods which become united so as to form a single long, straight spine.

Holothuria martensii, Semper, 1868 (Pl. VII. fig. 12; Pl. XVI. fig. 2).

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; green mud; a single specimen. Station 203, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; depth, 20 fathoms; mud; one individual.

In the contracted state the body has a length of 150 mm., and is provided with conical papillæ, which become largest towards the sides of the body, where they form a longitudinal series along the line of junction of the dorsal and ventral surfaces. The largest papillæ have a length of about 7 mm. and a breadth at the base of about 4 mm. The papillæ, which are not very closely placed, decrease towards the middle of the dorsal and ventral surfaces; those on the dorsal surface being slightly more numerous and more distinctly pointed than the ventral ones, which seem to be more rounded. The closed mouth, which is ventral in position, is surrounded by a circle of smaller papillæ. The anus is terminal, roundish, and has a few very small papillæ on the margin. The tentacles are twenty (?), fully retracted and small. The colour is whitish or pale greyish on the sides, and darker on the dorsal and ventral surfaces from numerous, crowded, minute, brownish specks. The inside of the perisome is characterised by numerous small dark dots.

The calcareous ring (Pl. VII. fig. 12, *c*) is of the usual shape without posterior prolongations. The madreporic canal, 10 mm. long, terminates in a pear-shaped end. A single Polian vesicle, about 50 mm. long, is present. The genital tubes are twice or three times dichotomously branched. A thick bundle of short Cuvierian organs is present.

The calcareous deposits closely resemble those in *Holothuria ocellata*, to which this species is nearly related, excepting that the tables are provided with an elongated conical spire composed of four rods and as many as six or seven transverse beams. The top of the spire generally carries several small spines, but I have also found tables which are almost devoid of spines. Sometimes the four rods which constitute the spire of the tables carry spines, but I never found such large ones as those figured by Semper. The disk of the tables is rather large and pierced by more holes than in *Holothuria ocellata*. The tables (Pl. VII. fig. 12, *a*, *b*) measure from 0·1 mm. to 0·16 mm. in height. The papillæ have almost a spinous appearance from the long spires of the table. The numerous buttons and supporting rods of the papillæ are exactly like those in the above-named species. In this specimen also many elongated buttons with numerous holes in two rows are to be found, but those with six holes are the most common. The elongated buttons with numerous holes are rarer, and it is to be observed that the knobs on these are less prominent, sometimes nearly inconspicuous. Though the specimen does not fully agree with the description given by Semper, the similarity is very obvious. The specimen examined by Semper is much smaller.

The papillæ are supported by numerous solid rods which are either perforated at

the middle and at each end, or have a more or less complete series of holes along each side.

The above description concerns the specimen from Station 188. That obtained at the Philippine Islands is considerably smaller, only 85 mm. long, and its colour is darker from a greater abundance of slightly larger brownish specks. The odd ambulacrum is marked out by a narrow dark line. The specimen agrees in all points with the above description, excepting in the size of the papillæ, which here are comparatively slightly larger, and, above all, in the shape of the buttons. In the specimen from Station 188 the knobbed buttons with six holes are by far the most common. In this individual, on the contrary, it is rarer to find these smaller buttons, while the more elongated kind with numerous holes are abundant. Thus, I have found here a whole series of transitional forms of buttons from those with six holes to a very elongated, narrow form, 0·14 mm. long, with as many as sixteen holes, eight in each row. In the longest buttons the knobs almost disappear. Considering the great resemblance in all other points, and that such long buttons with numerous holes are not rare even in the specimen from Station 188, I think the two forms must be referred to the same species, though possibly the smaller form may be considered as a variety.

Holothuria ocellata, Jæger, 1833 (Pl. VII. fig. 11; Pl. XVI. fig. 1).

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; green mud; one specimen.

There seems to be but little doubt that these animals, brought home from the neighbourhood of Torres Strait, are identical with Jæger's form found at Celebes.

The animal, which in the contracted state has a length of about 170 mm. and a breadth of 55 mm., is of cylindrical form, rounded anteriorly and slightly more tapering posteriorly. The dorsal surface is strongly convex, the ventral almost flat or inconsiderably convex. The body is angular along each side on the line of junction of the two surfaces, which thus become more distinct from one another. The mouth with the retracted tentacles has a ventral position, and the round anus is terminal. The anus is surrounded by very small, elongated, conical papillæ. The whole surface of the body is covered by larger and smaller conical papillæ or prominences, which do not seem to be retractile; the largest papillæ, about 7 mm. long and 4 mm. broad at the base, are situated along the angles of the sides of the body, forming a kind of brim along the sides; those on the ventral surface are slightly smaller than the dorsal. Tentacles twenty (?), of unequal size. Round the closed mouth is a series of papillæ. Colour in alcohol, whitish, with minute brownish specks or dots, which are more crowded along the middle of the ventral surface, which is thus darker; on the dorsal surface the specks are more confluent so as to

cause a reticulate appearance. A dark brownish circular ring surrounds the bases of the papillæ, and this ring is in its turn encircled by a second whitish ring, which is especially distinct on the back. The upper part of the papillæ is whitish. The papillæ along the angles of the body, however, are not enclosed by these rings, which are confluent and form an irregular, undulated dark line along each side above the row of papillæ and another line, though more indistinct, on the ventral surface.

The calcareous ring (Pl. VII. fig. 11, *f*) is of the usual shape without posterior processes. A single large madreporic canal with the free end enlarged and pear-shaped, and several (seven) Polian vesicles are present. The reproductive organs are made up of a single bundle of long, cylindrical, narrow tubes, which are bipartite or tripartite only at the base.

The integument is not very thick, and contains tables and knobbed buttons. The tables (Pl. VII. fig. 11, *a*, *b*, *c*) are robust, and their perforated disk is mostly smooth on the margin and convex on the inner surface; I have sometimes seen spines on the margin. The spire is usually short, about 0·048 mm. long, broad and built up of four rods, united by a single transverse beam under the top, which is mostly rounded and covered with spines. Among these tables I have also seen others with the spire more slender and with two transverse beams and also a few with a larger, more irregularly reticulate disk and a slender, longer spire with about three transverse beams. The most common buttons (Pl. VII. fig. 11, *d*) are oval, with six holes and two knobs on the middle beam and some less prominent ones on the margin. Their length is about 0·04 mm. But I have also found much more elongated buttons with numerous holes in two rows and many knobs, so that the margin becomes very uneven. A series of transitional forms is to be found between the extremes. The papillæ are strengthened by strong, curved rods (Pl. VII. fig. 11, *e*), with perforated ends, and dilated and provided with holes, at the middle only, or along one or both sides. Semper's *Holothuria squamifera* is doubtless nearly allied to this species of Jæger, which, however, is devoid of smooth buttons, &c.

Holothuria impatiens, Forskaal, 1775 (Pl. VII. fig. 9).

Habitat.—Fiji Islands; a single specimen. Sandwich Islands; one specimen.

The incomplete specimen brought home by the Challenger Expedition from the Fiji Islands has a length of about 95 mm. The calcareous ring, tentacles, &c., are destroyed. The colour in alcohol is pale greyish or reddish-brown, excepting along the dorsum, where it is auburn. The rounded warts which carry the pedicels are pale, inclining to yellowish, excepting along the back, where they are darkish brown. The surface of the perisome is rough from the spinous tops of the tables. The tables (Pl. VII. fig. 9, *a*, *b*, *c*) have a height of about 0·068 mm., and their disks measure 0·11 mm. in diameter. The

disks have quite a smooth margin, and the number of holes seems, as a rule, to be nine. The buttons (Pl. VII. fig. 9, *d*) are smooth and mostly regularly formed with six holes in two rows; their length is about 0·08 mm. The rods in the pedicels (Pl. VII. fig. 9, *e*) have commonly the form given on the plate. A bundle of very large, unbranched Cuvierian organs, about 50 mm. long, is present.

The specimen obtained at the Sandwich Islands mainly differs in its uniform brown colour and in the smallness of its slightly darker coloured warts.

Holothuria vagabunda, Selenka, 1867 (Pl. VII. fig. 10).

Habitat.—Tongatabu (Friendly Islands); one individual. Samboangan (Philippine Islands); one individual. Fiji Islands; a single specimen.

I am in great uncertainty with regard to the ambulacral appendages of the dorsal surface, they may be considered either as pedicels or papillæ. Some of them have a more or less obviously conical form and resemble papillæ, others are more cylindrical; a closer examination proves that the former are devoid of a true sucking-disk, have the terminal plate very rudimentary and the walls strengthened by numerous spinous transverse rods, while the latter have a small though distinct sucking-disk, a much larger terminal plate and comparatively few supporting rods; these rods are only collected around the terminal plate, and are not distributed over a greater space as is the case in the papillæ, and, like those in the ventral pedicels, they generally resemble elongated plates with two more or less incomplete rows of holes, or bilaterally symmetrical, fenestrated, more or less elongated plates. Evidently, then, the dorsal ambulacral appendages are of two kinds, viz., pedicels and papillæ. The ventral appendages are slightly more numerous than the dorsal ones; in the specimen from Tongatabu they seem to be much more numerous and crowded; this, however, depends upon a higher degree of contraction of the ventral perisome.

The colour of the individual from the Philippine Islands is pale brown, while the specimen from Tongatabu is darkish brown. I cannot with certainty state the number of tentacles which are fully retracted within the body, but I believe there are eighteen in the specimen from Tongatabu. A single madreporic canal is present. The individual from Tongatabu is provided with three Polian vesicles, while the other has only one or two. Cuvierian organs of a reddish-brown colour are present. The deposits obviously resemble those in the typical *Holothuria vagabunda;* scattered among the common tables with the wide annular apex of the spire provided with eight to ten teeth, others are found with their spire much more tapering towards the apex, which becomes very narrow and comparatively inconsiderable. The disks of the tables (Pl. VII. fig. 10, *a*) are often uneven in the margin and even spinose, but there are also many disks to be found which have the margin rounded, smooth, and slightly undulating. The

buttons (Pl. VII. fig. 10, *d*) have generally six holes, but it is not very rare to find them with eight holes, especially in the papillæ.

The third specimen, obtained at the Fiji Islands, is like that from the Philippine Islands in colour and general appearance.

Holothuria atra, Jæger, 1833 (Pl. VII. fig. 4).

Habitat.—Amboina; a single individual. Fiji Islands; a single specimen. Station 177, August 18, 1874; lat. 16° 45′ S., long. 168° 7′ E.; depth, 130 fathoms; bottom, volcanic sand; a single specimen.

Each of the specimens obtained at the above mentioned Stations has a length of about 180 mm.; when fully extended they must be much longer. The dorsal papillæ are much more scattered than the ventral pedicels, and do not exceed them in size. Some of the tentacles seem to be absent in the specimen from Amboina. The deposits have been already correctly described by Selenka. The small disks of the tables (Pl. VII. fig. 4, *a*) are either smooth on the margin or provided with spines. Close to the well-developed terminal plate of the pedicels, fenestrated, often symmetrically bilateral plates are to be found. The papillæ, on the contrary, contain slightly curved, smooth, or spinous rods, mostly with the enlarged ends fenestrated or branched. The colour is darkish brown, almost black. The Polian vesicles often seem to be more than three in number. The terminal plates of the dorsal papillæ are very rudimentary.

Holothuria curiosa, Ludwig (Pl. VIII. fig. 9).

Habitat.—Samboangan (Philippine Islands).

The only specimen brought home by the Challenger Expedition almost completely agrees with that described by Ludwig. Its length is about 100 mm., and its colour is greenish-brown, darker on the dorsal surface, and almost black round the anal aperture. A fine distinct darkish brown ring surrounds the bases of the pedicels and papillæ. The pedicels are slightly more crowded than the papillæ. The very small, irregularly but closely placed dorsal papillæ seem to be situated on small warts. The slightly larger ventral pedicels are also scattered without order. The anus is round, and the mouth surrounded by a slight brim.

The calcareous ring is of the usual shape without posterior prolongations. Unlike the animals examined by Ludwig, the Challenger specimen is furnished with only a single vesicle, 25 mm. long.

The single, free, dorsal madreporic canal has a length of 6 to 7 mm. The reproductive organs are very small, and their fine, narrow tubes are once or twice

dichotomously branched. A bundle of a few rather large, simple Cuvierian organs is present.

The deposits are not very well developed. The buttons (Pl. VIII. fig. 9, *b*) are very irregularly formed, with from two to six holes; their length is as much as 0·03 mm. Near the ambulacral appendages the buttons often become larger and the number of holes greater (Pl. VIII. fig. 9, *c*). The tables (Pl. VIII. fig. 9, *a*) have the disk small, often rudimentary and confined to a simple ring; in the larger tables the disk measures 0·03 mm. in diameter. The spire of the tables is more or less rudimentary; compare the figures. The pedicels are strengthened by perforated rods or rod-like plates (Pl. VIII. fig. 9, *d*), with the holes often arranged in two longitudinal series. In the papillæ, which have a very poorly-developed terminal plate, the deposits seem to be a little more rod-like than in the pedicels.

Holothuria fusco-rubra, n. sp. (Pl. VII. fig. 2).

Habitat.—Sandwich Islands; a single specimen.

This specimen seems to be nearly allied to the preceding species, with which it agrees in nearly all respects. I may therefore refer to the description of Ludwig, while I here only point out the differences. When fully extended it attains a considerable size; its colour is uniformly dark brown inclining to reddish, and the brown rings of the pedicels and papillæ are totally absent. The pedicels are much more numerous than the dorsal papillæ, which are comparatively few, so that an obvious line of demarcation is visible between the dorsal and ventral surfaces. There are also some slight differences in the deposits. Thus the disks of the tables (Pl. VII. fig. 2, *a*), about 0·06 mm. in diameter, have the margin very uneven and often provided with spines. The spire of the tables is totally absent or reduced to a few short spines (commonly four), the apices of which are very seldom joined by transverse beams. When such transverse beams were present, I never found any teeth, characteristic of the tables in other Holothurians. The most incompletely developed buttons (Pl. VII. fig. 2, *b*) have a length of about 0·06 mm.; in a complete state the buttons are pierced by six holes in two rows. In the ambulacral appendages longer buttons with more holes are to be found. The pedicels, which are more crowded than the papillæ, bear near their ends fenestrated irregular plates (Pl. VII. fig. 2, *c*), and the scattered small dorsal papillæ are strengthened by slightly curved and spinous rods. The Cuvierian tubes are very well developed.

So far as I can see, this form cannot be referred to any previously described species, though it bears the closest resemblance to several of them, especially to *Holothuria curiosa*, *Holothuria vagabunda*, and *Holothuria lagoena*.

Holothuria lactea, n. sp. (Pl. X. figs. 9 and 15).

Body elongated, oval. Mouth turned towards the ventral surface. Anus almost terminal. Tentacles small, twenty. A simple row of pedicels along each side of the ventral surface. The odd ambulacrum naked. Dorsal surface with small, very much scattered papilla-like prominences. Perisome soft and pliable, containing numerous crowded delicate tables consisting of a large rounded or stellate disk pierced by six very large holes arranged round a small central hole, and bearing a strongly constructed central spire built up of three rods and one transverse beam; the spire terminates in three very long smooth teeth. Colour, milk-white. Length about 110 mm.

Habitat.—Station 78, July 10, 1873; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; volcanic mud; two fragments. Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms; bottom temperature, 40°·0; blue mud; a single individual.

The ventral surface is evidently flatter than the dorsal, and does not bear any other ambulacral appendages than the simple row of pedicels along each side. These pedicels, only about twenty in each row, are not closely crowded but placed at some distance from each other, and measure about 8 mm. in length; their ends are slightly enlarged, the pedicels thus acquiring a clavate appearance. The terminal plates of these pedicels are not very well developed. The enlarged ends of the pedicels are strengthened by numerous crowded, almost smooth, more or less curved, transverse, unbranched rods. The pedicels also contain more or less deformed tables in great abundance. The very minute papilla-like dorsal ambulacral appendages are few and scattered; besides a rudimentary terminal plate and a great number of more or less deformed tables, they contain a few curved spicules. The twenty tentacles are small and seem to terminate in about four processes. The perisome is filled up by tables (Pl. X. fig. 9) which have a very characteristic shape. The disks of these tables have a very fine conformation, and their circumference is either rounded or stellate with six angles; they are pierced by six large peripheral holes and a small central hole; the diameter of the disks is about 0·2 mm. The spire (Pl. X. fig. 15, *b*) is more firmly constructed, and attains a length of about 0·24 mm.; it consists of three rods joined near the base by a transverse beam; from the apex, where the three rods are united, three long, slender, smooth, divergent teeth arise. In the pedicels and papillæ especially the disks of the tables are more or less deformed. A single short Polian vesicle is present. The small madreporic canal is attached by its tubercle to the dorsal body-wall in its middle line. The reproductive organs are situated on the left side of the dorsal mesentery, and consist of several genital tubes, each terminating in a bundle of short slightly branched sacs, within which the eggs are visible. The longitudinal muscular bands are simple and without retractors. Two wide and well developed respiratory-trees are present and do not seem to be in any

intimate connection with the vessels of the pseudhæmal system. The above diagnosis and description refers to the individual obtained at Station 169.

The fragmentary specimens obtained at Station 78 are doubtless identical with the preceding form; their deposits have exactly the same appearance.

Holothuria thomsoni, n. sp. (Pl. X. figs. 8, 11).

Body oval. Mouth turned downwards. Anus almost terminal. Tentacles twelve in number, in general shape like those in Aspidochirotæ. A simple slightly alternating row of pedicels along each side of the ventral surface, and some small papillæ scattered on the ventral surface in the neighbourhood of these rows. No other ambulacral appendages are visible on the exterior. Perisome unusually rough, from an abundance of crowded tables consisting of large, irregularly perforated disks with the central hole usually smaller than the peripheral ones; the spire is composed of three rods and one transverse beam, and terminates in three very long, slender, and spinous teeth. Colour in alcohol, greyish. Length about 125 mm.

Habitat.—Station 237, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; depth, 1875 fathoms; bottom temperature, 35°·3; blue mud; a single incomplete specimen. Station 244, June 28, 1875; lat. 35° 22′ N., long. 169° 53′ E.; depth, 2900 fathoms; bottom temperature, 35°·3; red clay; three specimens.

The body seems to be more flattened on the ventral than on the dorsal surface. Each of the two rows of pedicels contains forty to fifty. The length of these pedicels and their breadth at the base are about 5 mm. Excepting the small papillæ or pedicels in the neighbourhood of the rows above mentioned, no other ambulacral appendages are visible protruding beyond the surface of the skin; but, on examining the inner surface of the perisome, one finds a great number of small pores along the odd ambulacrum and a very few scattered on the back, which possibly may indicate the presence of minute pedicels. The tables (Pl. X. fig. 11, *a*, *b*) bear a certain resemblance to those in the preceding species, but the disks are more irregular and are provided with a greater number of holes; their spire is characterised by the spinous teeth. The disks measure about 0·26 mm. in diameter, and the spire is of about the same length. The pedicels possess, besides a rudimentary terminal plate, smaller, more regularly perforated tables (Pl. X. fig. 11, *d*, *e*) and slightly curved and spinous rods (Pl. X. fig. 11, *c*). The calcareous ring is narrow, fragile, and of the usual shape, without posterior prolongations. The longitudinal muscles are simple and devoid of retractors. A bundle of three small Polian vesicles is present.

The specimens brought home from Station 244 deviate in some degree from the above diagnosis, and in some respects they are more nearly allied to the preceding species. In fact, the deposits closely resemble those in *Holothuria lactea;* thus the

disks of the tables are very symmetrical, star-like, with six larger holes round the smaller central aperture (Pl. X. fig. 8). Only a simple row of from nine to fourteen elongated pedicels is present on each side of the ventral surface; besides these, no other pedicels or papillæ seem to exist. In one individual I observed thirteen small tentacles.

Holothuria thomsoni, var. *hyalina*, nov.

Habitat.—Station 158, March 7, 1874; lat. 50° 1′ S., long. 123° 4′ E.; depth, 1800 fathoms; bottom temperature, 33°·5; Globigerina ooze.

The single specimen obtained by the Challenger Expedition has a length of 68 mm. Its body-wall is glassy from numerous crowded tables, exactly like those in the type form excepting that the three teeth of their spire are less spinose. Tentacles fifteen. The pedicels are not very distinct, but, so far as I can judge from the incomplete specimen at my disposal, they are few and arranged in a simple row along each side of the ventral surface. Having been unable to detect any other peculiarities, I propose for the present to consider the specimen in question as a variety of *Holothuria thomsoni*.

Holothuria murrayi, n. sp. (Pl. X. figs. 16–18).

Body elongated, more or less distinctly cylindrical, with mouth and anus almost terminal. Tentacles twenty. Each lateral ventral ambulacrum with numerous pedicels, the larger of which seem to form a continuous row along each side of the body; the remaining pedicels are of unequal size, and sparsely distributed over the adjacent interambulacra. The odd ambulacrum with numerous, very minute, almost imperceptible pedicels. Dorsal surface with few, small, and scattered papilla-like pedicels. The dorsal as well as the ventral interambulacra have only a few minute ambulacral appendages in their middle line. Perisome thin, flexible, and rough from closely placed tables, consisting of a more or less irregular, perforated disk, typically with six large holes round a central hole, and a spire built up of three rods and one transverse beam. The spire terminates in three rather long teeth, the free ends of which are spinose or branched. Colour in alcohol, greyish inclining to violet, which is especially obvious along the middle of the ventral surface; some larger violet spots are visible on the dorsal surface, evidently indicating that this colour predominates during life. Length, 240 mm.

Habitat.—Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; depth, 1375 fathoms; bottom temperature, 35°·5; Globigerina ooze; two individuals.

The mouth is slightly bent towards the ventral surface. The cylindrical pedicels of the ventral ambulacra meet each other in the middle of the interambulacra, where,

however, their number is very limited. As is pointed out in the diagnosis, the larger pedicels form a distinct simple row along each side of the body. These larger pedicels have a length of 7 mm. or more, and a breadth of 1·5 mm. or less. The pedicels of the odd ambulacrum are so small that they are scarcely visible to the naked eye. The few and very scattered dorsal ambulacral appendages present, perhaps, a conical form, which, however, is by no means well marked; they do not attain the size of the large lateral pedicels above mentioned. The middle of the odd interambulacrum seems to be almost naked. The tentacles are drawn within the body, but seem to have the structure common to the Aspidochirotæ.

The calcareous ring (Pl. X. fig. 16) is devoid of any posterior prolongations. A single short ventral Polian vesicle is present. The single dorsal madreporic canal is attached to the dorsal mesentery. A bundle of short, slightly branched, slender genital tubes is situated on the left side of the dorsal mesentery. The two respiratory-trees are well developed, but are not in any intimate connection with the pseudhæmal vessels. The longitudinal muscles are simple, and there are no retractors.

The tables vary greatly in size and shape, some having a nearly regular hexagonal disk with six large peripheral holes and a central smaller hole, others having the disk smaller, irregular, with the central hole larger than the surrounding ones (Pl. X. fig. 17). The diameter of the largest disks measures about 0·12 mm., while that of the smaller is only 0·07 mm. The height of the spire (Pl. X. fig. 18) varies from 0·12 mm. to 0·18 mm. But tables are often met with which have the disks perforated with more than six peripheral holes. The pedicels and dorsal appendages (pedicels?) are strengthened by terminal plates and more or less deformed tables, but they seem in general to be devoid of transverse rods. The terminal disks of the dorsal appendages are more rudimentary. The above diagnosis and description refer to the large, well-developed individual. The smaller specimen, 57 mm. long, obtained at the same Station is much contracted and wrinkled, but here it becomes more evident that the dorsal appendages at the anterior extremity of the body are of a conical form.

The two specimens brought home from Station 298 resemble the small one obtained at Station 300; one of them, however, is devoid of deposits in the integument, probably a result of the influence of some acid in the alcohol. In the other specimen, on the contrary, the greater part of the deposits is left uninjured; they closely resemble those above described, excepting that the three teeth of the spire are less spinose. The individual deprived of deposits seems to have the dorsal ambulacral appendages more numerous and like pedicels.

Holothuria murrayi, var. *parva*, nov. (Pl. IX. fig. 2; Pl. XVI. figs. 4, 5).

Habitat.—Station 219, March 10, 1875; lat. 1° 54′ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; coral mud; one individual.

There is good reason for referring this form to a new species, but considering that it presents in several respects great similarities to *Holothuria murrayi*, and that I have had at my disposal only a single specimen, I prefer for the present to regard it as a variety of this species. Length, 72 mm. Body fusiform, about 23 mm. broad at the middle. Pedicels numerous, cylindrical, about 2·5 mm. long, scattered over the dorsal surface and the sides of the body. The pedicels of the ventral surface are very minute and scarcely visible to the naked eye. Colour yellowish-white. Deposits—tables with a spire composed of three arms with spinous apices and a single transverse beam (Pl. IX. fig. 2, *a*, *b*, *c*, *d*). Pedicels apparently without transverse supporting rods but with well-developed terminal plates. Mouth turned downwards; anus terminal. A single Polian vesicle. The figures will give the best idea of the external appearance of the animal and of the shape of the deposits.

Holothuria murrayi (var.?) (Pl. IX. fig. 3).

Habitat.—Station V., January 28, 1873; lat. 35° 47′ N., long. 8° 23′ W.; depth, 1090 fathoms; bottom temperature, 38°·5; Globigerina ooze.

A single specimen, 80 mm. long, differing from the typical form principally in that the ambulacral appendages, which are evidently true pedicels, are more numerous on the dorsal surface and the sides of the body. Even the calcareous ring (Pl. IX. fig. 3) is somewhat different, which will be understood from the figures. Colour greyish, inclining to violet. From the scanty materials I could not undertake any more detailed examination, but, so far as I can judge, there can be but little doubt that this form is identical with, or at least very nearly related to those brought home from Station 300.

The three species above mentioned, viz., *Holothuria lactea*, *Holothuria thomsoni*, and *Holothuria murrayi*, form a group by themselves among the numerous representatives of the genus *Holothuria*, and it is very probable that they may be properly placed in a new genus, or, at least, in a subgenus. Indeed, *Holothuria thomsoni* differs so strikingly from all forms hitherto known that I should not hesitate to refer it to a new genus if I had not had the opportunity of examining the two other forms, which evidently form a transition to the true *Holothuriæ*. *Holothuria thomsoni* is distinguished by twelve tentacles, and its variety by fifteen, numbers of tentacles hitherto unknown in any species of *Holothuria*. That which seems to be common to the three species above mentioned and their varieties is, firstly, the conformation of the calcareous deposits, and secondly, the peculiarity that the pedicels of the two lateral ventral ambulacra either form a simple distinct row, or that, if they are more numerous and crowded, some of them are larger and more or less distinctly arranged in a row along each side of the body.

SURVEY OF THE GENERA AND SPECIES, HITHERTO KNOWN, BELONGING TO THE ASPIDOCHIROTÆ.

Family V. ASPIDOCHIROTÆ.

Body with mouth and anus at opposite poles. Tentacles peltate, twenty to thirty, seldom eighteen. Ambulacral appendages—pedicels alone, or pedicels together with papillæ, or papillæ alone; the papillæ often situated on the top of warts or more or less prominent processes. Retractors absent. Calcareous ring of ten pieces, regularly devoid of posterior prolongations; the radial pieces incised anteriorly, but not pierced. The left respiratory-tree generally in communication with the pseudhæmal vessels.

Genus 1. Labidodemas, Selenka, 1867.

Tentacles twenty. Ambulacral appendages—pedicels alone (?), arranged in double rows along each ambulacrum. Interambulacra naked. The single genital bundle situated on the left side of the dorsal mesentery. Anus devoid of teeth. C-shaped deposits present or absent.

Not having had the opportunity of examining any representative of this genus, I am by no means sure of the exactness of the above diagnosis. Both Selenka and Semper speak of pedicels, and do not mention anything about papillæ. The reason I have some doubts on the nature of the ambulacral appendages, is that Selenka points out that the ventral pedicels alone are provided with terminal plates, and, above all, because Ludwig speaks of dorsal "papillæ." So far as I can see, the only character distinguishing the genus *Labidodemas* from the genus *Holothuria* is to be found in the arrangement of the pedicels, and it may be questionable whether this is satisfactory.

Labidodemas semperianum, Selenka, 1867.

Deposits—tables with the spire formed by five rods and terminating in ten teeth; smooth buttons; and numerous rods or C-shaped bodies.

Habitat.—Sandwich Islands (Selenka).

Labidodemas selenkianum, Semper, 1868.

Habitat.—Fiji Islands (Semper).

On comparing the descriptions of Semper and Selenka, it is nearly impossible to discover any differences between this species and the preceding. The

C-shaped rods, however, seem to be absent in this species (?). With regard to the arrangement of the pedicels, Selenka says that the pedicels of the odd ambulacrum and those forming the inner row on the two lateral ventral ambulacra are twice as many as those in the remaining rows. Semper, on the contrary, remarks that the ventral pedicels in his species are more crowded than those on the dorsal surface. These differences must be more plainly illustrated.

Labidodemas dubiosum, Ludwig, 1875.

The ventral "pedicels" and the dorsal "papillæ" arranged in double rows along the ambulacra. Deposits—rare, irregular, oval buttons; tables with the disk small, almost annular, and with the short spire built up of four rods and one transverse beam, and having the top terminating in about five long, simple (or bifurcate) spines.

Habitat.—Tahiti (Ludwig).

This species does not seem to be well defined from the preceding ones.

Genus 2. Stichopus, Brandt, 1835.

Tentacles eighteen to twenty. Ambulacral appendages in the shape of pedicels and papillæ; the former arranged in three more or less distinct longitudinal series on the ventral surface; the latter mostly situated on the tops of larger or smaller protuberances, forming rows along the dorsal ambulacra, or scattered all over the dorsal surface. Two bundles of genital tubes, one on each side of the dorsal mesentery. Anus devoid of calcareous teeth. C-shaped deposits often present in the perisome.

A. C-Shaped deposits present. Tentacles eighteen or twenty.

1. *Dorsal ambulacral appendages present only on the ambulacra.*

a. Deposits—C-shaped bodies; and tables of one kind consisting of a smooth, rounded, perforated disk, supporting a spire of four rods and one transverse beam; the truncated apex of the spire terminating in several teeth.

Stichopus chloronotus (subgenus *Perideris*), Brandt, 1835; Selenka, 1867; Ludwig, 1881, 1882. *Stichopus cylindricus*, Haacke, 1880.

Tentacles twenty. Papillæ on rather prominent conical warts, forming a double row along each dorsal ambulacrum, and a zigzag or double row along each side of the body. Spire of the tables terminating in eight to twelve teeth.

Habitat.—Zanzibar (Selenka), Querimba and Mozambique (Semper), Indian Ocean (Ludwig), Mauritius (Haacke, Ludwig), Macassar (Ludwig), Lugunor and Guahan (Brandt), Sandwich Islands (Selenka), Pulo Tikul, Nicobar Islands, Pelew Islands,

Molucca Islands, Navigator and Fiji Islands (according to Semper), Darros Island (Bell).

(Mus. Holm.) Several specimens from unknown localities. In addition to C-shaped deposits and tables, I find some very scattered incomplete rosettes.

Stichopus haytiensis, Semper, 1868.

Tentacles twenty. Papillæ on rather prominent protuberances, arranged in four rows along the dorsal surface. Spire of the tables terminating in twelve teeth.

Habitat.—Hayti (Semper), Puerto Cabello (Ludwig).

Differs from the preceding species apparently in that the dorsal papillæ form four simple rows, and in having the ventral pedicels sparsely distributed in "five" broad series.

Stichopus errans, Ludwig, 1875.

Tentacles nineteen. Papillæ, fewer in number, situated on low warts. Spire of the tables terminating in twelve or sixteen teeth.

Habitat.—Barbados (Ludwig).

The description is not fully satisfactory. With regard to the papillæ, Ludwig only says that they seem to belong to the ambulacra alone, but does not explain how they are arranged.

(Mus. Holm.). One specimen dredged at St. Thomas. It is very wrinkled and contracted, so that it is impossible to state the arrangement of the dorsal papillæ; as it seems to me, they are placed on low warts forming a row along the sides of the body, and possibly such warts may even be observed on the two dorsal ambulacra. I cannot decide whether or no there are small papillæ on the interambulacra. Tentacles nineteen (or eighteen?). The radial pieces of the calcareous ring, excepting the middle ventral one, are provided with a short posterior, deeply incised prolongation. The deposits are like those described by Ludwig, excepting that the greater part of the tables are destitute of disks or have rudimentary ones. The species is possibly identical with the preceding.

b. Deposits—C-shaped bodies; tables like those in the preceding species; and large robust tables remarkable in having the conical spire terminating in a single point and possessing several transverse beams.

Stichopus horrens, Selenka, 1867.

Tentacles twenty. Papillæ on rather large conical prominences, arranged in four rows along the dorsal surface. In addition to C-shaped bodies, incomplete rosettes, and small tables, like those in the preceding species terminating in twelve to sixteen teeth, much larger tables of the same construction are found; and, besides, large robust tables with the conical spire terminating in a single point.

Habitat.—Society Islands (Selenka).

2. *Dorsal ambulacral appendages scattered on the ambulacra as well as on the interambulacra.*

a. Deposits—C-shaped bodies; tables like those in the preceding species, thus larger and smaller tables with the truncated apex terminating in several teeth, and large robust tables with the conical spire terminating in a simple point.

Stichopus godeffroyi, var. *b*, Semper, 1868.

Tentacles twenty. The dorsal appendages on the ambulacra seem to be slightly larger than those on the interambulacra, and the presence of the latter appears to be the only character distinguishing this species from *Stichopus horrens*.

Habitat.—Navigator Islands (Semper).

(Mus. Holm.) Several specimens from the Friendly Islands, Navigator Islands Fiji Islands, and Pelew Islands. A few of the dorsal papillæ run out from slightly larger protuberances, and this is especially the case with a part of those situated on the sides of the body and on the dorsal ambulacra; however, the appendages never attain any very considerable size. An arrangement in rows of the larger appendages is not very distinct. Colour in alcohol, pale yellowish-grey, with darker stains on the back; ventral surface pale. In addition to C-shaped bodies and the two kinds of tables, incomplete rosettes.

b. Deposits—C-shaped bodies; and tables of one kind, viz., those with the spire built up of four rods and one transverse beam, and terminating in several teeth.

Stichopus variegatus, Semper, 1868. *Stichopus variegatus*, var. *herrmanni*, Semper, 1868. *Stichopus naso*, Haacke, 1880 (according to Ludwig, 1883).

Tentacles twenty. The dorsal appendages small, numerous. Spire of the tables terminating in four dentate points. Incomplete rosettes present.

Habitat.—Philippine Islands (Semper), Navigator Islands (Semper), Indian Ocean (Ludwig), Timor (Ludwig), Mauritius (Haacke, Ludwig), Port Molle (Bell).

(Mus. Holm.) Three specimens, one from the Pacific Ocean and two from the Fiji Islands. The former is 140 mm. long, of a yellowish-grey colour stained with brown and with minute blackish spots on the back. One of those from Fiji is nearly a foot long and of a darker colour. As a rule, the dorsal ambulacral appendages are minute.

Stichopus fuscus, Ludwig, 1875.

Tentacles twenty. "Dorsal papillæ not disposed in distinct rows." Spire of the tables terminating in numerous short teeth (as many as twenty-four). Rosettes absent.

Habitat.—Patagonia (Ludwig).

The species is not well known, its dorsal appendages being unsatisfactorily described. It is distinguished, however, by the numerous teeth on the top of the spire and by the fact that the pedicels in the odd ambulacrum form two series.

Stichopus möbii, Semper, 1868.

Tentacles eighteen. Dorsal surface without tubercles, but with irregularly disposed papillæ. Spire of the tables terminating in four dentate points. Incomplete rosettes present.

Habitat.—West Indies (Semper).

(Mus. Holm.) One very large specimen from West Indies, about 250 mm. long. In external appearance it closely resembles the specimens of *Stichopus variegatus* from the Pacific Ocean which I have seen, and it possesses even the minute blackish points I observed in several forms of that species. Tentacles twenty, not eighteen, but I suppose the species to be capable of some variations in this respect. The middle series of pedicels is much broader than the lateral, and contains six to eight pedicels in its breadth. The dorsal papillæ are small, scattered all over the back, and placed on the top of warts, which are very low excepting round the sides of the body, where they are more prominent and resemble rounded protuberances. The tables terminate in about fifteen or eighteen spines. I cannot refrain from offering the opinion that the species in question is possibly identical with *Stichopus variegatus*, and there seem to be good grounds in support of this supposition. According to Ludwig, even *Stichopus errans* is very nearly related to it. To decide this point, it will be necessary to know to what degree the variation in the number of tentacles and in the arrangement of the ambulacral appendages is possible. The species examined by me evidently bears greater resemblance to *Stichopus variegatus* than to *Stichopus möbii*.

Stichopus naso, Semper, 1868.

Tentacles eighteen. Dorsal surface with very large conical processes, upon and between which the papillæ are situated. Body-wall exceedingly thick. The lateral series of pedicels become rudimentary anteriorly. Body distinctly quadrangular, narrower anteriorly.

Spire of the tables terminating in about twelve teeth. Incomplete rosettes present.

Habitat.—Philippine Islands (Semper, Ludwig).

c. Deposits—C-shaped bodies; and tables consisting of a cruciform four-armed disk, with the ends of the straight arms enlarged and pierced with a few holes; the spire is long, made up of four rows connected by three, four, or more transverse beams, each rod terminating in a simple point and carrying some spines.

Stichopus tizardi, Théel, 1882.

Habitat.—Færöe Channel (Théel).

When I first described this species I had only some fragments at my disposal. Lately I have received some new specimens dredged at about the same locality, but unfortunately even these are very deformed and macerated, consequently their true shape is difficult to state. The following may complete the former description. Body elongate, equally rounded at each extremity, flattened. Mouth ventral, with twenty yellow tentacles. Anus subdorsal. Dorsal surface with conical processes, few in number, of unequal size, the largest measuring 5 to 10 mm. in length; those processes which attain a greater size are thinly placed on or in the neighbourhood of the two dorsal ambulacra, while the smaller are to be found partly in very limited numbers scattered among the larger, partly more crowded, forming a simple row along the sides of the body and round its anterior extremity. The pedicels probably form a double row along each lateral ventral ambulacrum, but on the odd ambulacrum, marked out by a deep furrow, I could not convince myself of the presence of any such appendages. The calcareous ring is very reduced, in the larger specimens absent. Two genital bundles, one on each side of the dorsal mesentery. A single Polian vesicle and madreporic canal. Body-wall thick, strengthened by **C**-shaped bodies and tables. In some parts of the body the spires grow much larger, and possess much more numerous transverse beams; in others all the tables become very robust, with a greater number of holes in the highly dilated ends of the arms, and with the spire more irregularly developed and highly spinous. As a rule, the four rods which constitute the spire are almost parallel and provided with spines. The dorsal processes carry numerous spinous rods and tables with very long spires.

B. C-shaped bodies absent. Tentacles twenty.

1. *Dorsal ambulacral appendages on the ambulacra as well as interambulacra.*

a. Deposits—tables like those in *Stichopus tizardi*.

Stichopus natans (*Holothuria*), Sars, 1868, 1871.

Habitat.—West coast of Norway and Sognefjord (Danielssen and Koren, Storm), Lofoten, Bergen, Hardanger (Sars).

(Mus. Holm.) Three types from Norway.

The species differs from the preceding one by the lack of **C**-shaped deposits; for the rest they seem to be very nearly related. Even Sars states the absence of pedicels on the odd ambulacrum. Some of the dorsal processes attain a considerable length, about 23 mm., especially those situated on or near the dorsal ambulacra.

b. Deposits—tables consisting of a large, rounded, richly perforated disk, supporting a long conical spire, built up of four rods which are spinous all over their length and joined by four to five transverse beams.

Stichopus regalis (*Holothuria*), Cuvier, 1817; Selenka, 1867; Sars, 1857. *Holothuria columnæ*, Cuvier, 1817. *Holothuria triquetra*, Delle Chiaje, 1828.

Habitat.—Mediterranean Sea (Sars, Selenka, Græffe, Heller, Grube, Ludwig, &c.). Australia? (Semper), Canary Islands (Greeff), Bay of Biscay (Norman).

(Mus. Holm.) One specimen from Naples. The dorsal appendages are larger on the distinct sharp margin, which marks the transition between the dorsal and ventral surfaces, but they decrease towards the middle line of the dorsum; they never attain any greater size. In some disks of the tables I counted more than fifty holes, and, as a rule, the disks are remarkable for having a great number of holes; even the spires of the tables are characteristic in that their four rods bear spines not only at their apex but even along almost all their length. Rosettes absent.

c. Deposits—tables of two kinds, like those in *Stichopus godeffroyi*, var. *b*, thus larger and smaller tables with the truncated apex of the spire terminating in several teeth, and large robust tables with a conical spire terminating in a simple point.

Stichopus godeffroyi, Semper, 1868.

The truncated spires terminate in eight to twelve teeth. Incomplete rosettes present. Four rows of larger dorsal appendages, and numerous small ones scattered over the interambulacra.

Habitat.—Navigator Islands (Semper).

d. Deposits—tables of one kind, viz., those with the spire built up of four rods and one transverse beam (seldom two or more), and terminating in several teeth.

Stichopus godeffroyi, var. *pygmæus*, Semper, 1868.

Like the preceding species; the disks of the tables are larger.

Habitat.—Fiji Islands (Semper), Navigator Islands (Semper).

Stichopus japonicus, Selenka, 1867; von Marenzeller, 1881.

The tables are of different sizes, and their spire is mostly built up of four rods joined by one, two, or more transverse beams; the spire terminates in four

smooth or slightly spinous teeth. In addition to these deposits, Selenka mentions numerous perforated disks devoid of spires. Rosettes absent. The dorsal appendages are larger along the sides of the body, where they form a distinct row.

Habitat.—Japan (Selenka, von Marenzeller).

(Mus. Holm.) Two specimens dredged at Hong Kong, which may probably be regarded as typical. They attain a length of 200 mm. The dorsal papillæ are distributed all over the back, and some of them are situated on large conical processes, which have a length of about 17 mm. and a breadth at the base of 13 mm.; these processes form a simple row along each side of the body and a more irregular alternating double row along the dorsal ambulacra. They agree in all respects with those dredged during the Challenger Expedition, excepting that the deposits have almost exclusively the shape of perforated disks; it is very rare to find any complete tables.

Stichopus maculatus, Greeff, 1882.

Spire of the tables terminating in fourteen to sixteen external and eight internal spines or teeth. Rosettes absent. Dorsal appendages in the shape of thick, high warts, between which smaller ones are placed.

Habitat.—Rolas (Greeff).

The arrangement of the dorsal papillæ is not fully clear.

Stichopus assimilis, Bell, 1883.

Disks of the tables reduced to simple, uneven, or spinous rings, and the spire terminating in about eight (?) teeth. In addition to these deposits, flattened reticulated bars of very characteristic appearance. Rosettes absent. Dorsal papillæ abundant and well developed.

Habitat.—Angola (Bell).

The species in question is too unsatisfactorily known to decide whether it is really a distinct species. The "flattened reticulated bars" seem to be nothing other than perforated rods or bars supporting the papillæ or pedicels. A further examination will prove whether there exists any distinguishing character between this form and the preceding one.

Stichopus kefersteinii, Selenka, 1867.

Disks of the tables spinous in the margin; spire terminating in twelve teeth. Rosettes absent. Four rows of warts with papillæ along the dorsum, and scattered simple papillæ all over the back.

Habitat.—Acapulco (Selenka).

Stichopus sitchaensis (*Diploperideris*), Brandt, 1835; Ludwig, 1881. *Holothuria sitchaensis*, Stimpson, 1857.

Disks of the tables absent; spire built up of four short rods, joined by a transverse beam, each rod terminating in two or three short teeth. Rosettes absent. Dorsal appendages scattered.

Habitat.—Sitcha (Brandt, Ludwig).

The species is unsatisfactorily known.

e. Deposits—dichotomously branched, slender spicules (no true rosettes) and aggregations of innumerable minute grains.

Stichopus ananas (*Trepang*), Jæger, 1833; Semper, 1868; Ludwig, 1881. *Holothuria ananas*, Quoy and Gaimard, 1883; Selenka, 1867. *Holothuria grandis* (subgenus *Thelenota*), Brandt, 1833.

Dorsal appendages large, arranged in bundles, two to eight in each.

Habitat.—Polynesia and Java (Selenka), Celebes (Jæger), Bay of Geelvink in New Guinea (Ludwig), Carteret, New Ireland (Quoy and Gaimard), Lugunor in Caroline Island (Brandt).

(Mus. Holm.) A very large specimen, more than a foot long, from the Navigator Islands.

2. *Dorsal ambulacral appendages present only on the ambulacra.*

Stichopus badionotus, Selenka, 1867 and 1868.

Like *Stichopus chloronotus* in all respects, but distinguished by the absence of the **C**-shaped deposits.

Habitat.—Florida, (Acapulco ?) (Selenka).

The following species are more or less unsatisfactorily known and need re-examination :—

Stichopus armatus (*Holothuria*), Selenka, 1867; Semper, 1868.

Deposits—thinly scattered perforated disks. Rather large dorsal appendages form four irregular rows, and, besides, small scattered papillæ.

Habitat.—Hakodadi, Japan (Selenka).

The species is probably nothing else than a *Stichopus japonicus* (*?*).

Stichopus selenkæ, Barrois, 1882.

Deposits—widely open, rare C-shaped bodies; large irregularly formed, perforated plates; a few cruciform or star-like bodies, the latter with three arms.

Habitat.—Concarneau on the west coast of France (Barrois).

The description is summary and too incomplete to convey an exact idea of the animal. Barrois says that it resembles *Stichopus chloronotus* in external appearance. He does not mention anything about pedicels, papillæ, &c.

Stichopus lucifugus (*Holothuria*), Quoy and Gaimard, 1833; Brandt, 1835; Selenka, 1868.

Deposits—granulated, spinous, curved rods.

Habitat.—Carteret (Quoy and Gaimard).

Stichopus albifasciatus (*Holothuria*), Quoy and Gaimard, 1833; Brandt, 1835.

Habitat.—Tonga (Quoy and Gaimard).

Stichopus luteus (*Holothuria*), Quoy and Gaimard, 1833; Brandt, 1835; Selenka, 1868. *Holothuria monotuberculata*, Quoy and Gaimard, 1833. *Stichopus unituberculatus*, Brandt, 1835.

Habitat.—Tonga and Port Louis in Mauritius (Quoy and Gaimard), Mauritius (Hoffmann).

Stichopus sp., Bell, 1884.

Habitat.—Australia (Bell).

Allied to *Stichopus chloronotus*.

Genus 3. Mülleria, Jæger, 1833.

Tentacles twenty to twenty-seven. Ambulacral appendages in the shape of pedicels on the ventral surface and papillæ on the dorsal. Seldom an arrangement of the pedicels in longitudinal series visible. A single genital bundle present, situated on the left side of the dorsal mesentery. Anus surrounded by five calcareous teeth. No C-shaped deposits in the body-wall.

A. Tentacles twenty.

1. *Deposits—tables together with buttons or hollow fenestrated ellipsoids.*

Mülleria nobilis, Selenka, 1867; Semper, 1868. (?) *Holothuria maculata* (subgenus *Microthele*), Brandt, 1835 (according to Ludwig, 1881).

The robust tables have the spire terminating in sixteen to twenty teeth. The hollow fenestrated ellipsoids form a thick layer.

Habitat.—Zanzibar (Selenka), Mauritius (Haacke), Philippine Islands (Semper), Guahan (Brandt), Sandwich Islands (Selenka).

(Mus. Holm.) Some specimens from the Fiji Islands. Colour almost black, speckled with lighter tint. Dorsal papillæ more thinly scattered than the ventral pedicels, and of about the same size as or smaller than these. In the contracted state the dorsal surface seems to have some low protuberances, especially along the sides of the body. The anal teeth are small and surrounded by five groups of papillæ, each group corresponding in position with a tooth. The tables are thinly scattered, consisting of an irregularly rounded disk with smooth undulated margin and pierced with a large central and several smaller peripheral holes; the spire, formed by four rods and one transverse beam, terminates in twenty or more teeth. In one specimen it becomes evident that the papillæ partly run out from the body-wall itself, partly from more or less considerable protuberances, which for the most part are placed on the ambulacra.

Mülleria hadra, Selenka, 1867.

Habitat.—Society Islands (Selenka).

Like the preceding species, except in the conformation of the calcareous ring. According to the figures given by Selenka, the radial pieces of the ring in *Mülleria hadra* are narrower but much higher than in *Mülleria nobilis*, and possess anteriorly a single notch, while the latter species has no less than three low incisions.

Mülleria flavo-castanea, n. sp.

Deposits—tables and buttons. Disks of the tables with smooth margin and perforated with a large central hole and several smaller peripheral ones; the spire, built up of four rods and one transverse beam, terminates in twenty or more teeth. The buttons are large, oval, commonly with more than six (seven to twelve) holes; they are either completely smooth or provided with one, two, or more small elevations, which are mostly placed on the middle beam.

Habitat.—Madeira (Mus. Holm.).

Length, 100 mm. Colour—auburn, with a well-marked light yellowish space round the dorsal papillæ; papillæ themselves and pedicels dark auburn; tentacles lighter inclining to yellowish-green. Tentacles surrounded by papillæ. Anal teeth very minute, built up of a calcareous network. Pedicels crowded,

forming a kind of sole; in the space between the anus and the truncated end of the sole there are papillæ instead of pedicels. The dorsal papillæ, not so closely placed as the pedicels, are situated, apparently, on low wart-like bases. A single Polian vesicle and madreporic canal. Numerous Cuvierian tubes. The dorsal papillæ have curved spinous rods and larger irregularly rounded or oval, bilateral plates, while the pedicels are devoid of rods.

Mülleria excellens, Ludwig, 1875.

Deposits—tables and buttons. The short spire terminates in a rounded top with innumerable minute teeth; the oval buttons have six to eight holes and are finely spinose, especially round the margin.

Habitat.—Navigator Islands (Ludwig).

Mülleria parvula, Selenka, 1867. *Actinopyga parvula*, Verrill, 1867 to 1871.

Deposits—tables and buttons, the former with the truncated apex terminating in numerous teeth, the latter smooth and pierced with about six holes. Colour uniformly auburn.

Habitat.—Florida (Selenka).

As will be understood from the above descriptions, *Mülleria parvula* is distinguished from *Mülleria flavo-castanea* by the colour, by the number of holes in the buttons, by the absence of Cuvierian organs, &c. Notwithstanding this, further investigations may possibly show the former to be the young of the latter. *Mülleria excellens* differs from *Mülleria parvula* mainly in the rounded, very spinous apex of the tables as well as by the spinous buttons. Among the collections of Holothurians in the Zoological State Museum at Stockholm a small *Mülleria*, 30 mm. long, is preserved from the Navigator Islands. At first one may be inclined to refer it to *Mülleria excellens*, which lives at the same locality, but it is distinguished by the smooth buttons and in having a great part of the tables, like those in *Mülleria parvula*, provided with fewer spines in the truncated end of the spire, the rest of the tables bearing a nearer resemblance to those in *Mülleria excellens*. Either the two species of *Mülleria* are not distinct, or *Mülleria parvula* lives both in the Pacific and Atlantic Oceans—or the above-mentioned form is new to science, which seems less probable.

2. *Deposits—comparatively large* × *-shaped, slender, branched spicules, with the straight arms slightly dichotomous.*

Mülleria formosa, Selenka, 1867.

The very slender × -shaped bodies have the arms rather straight, narrow, tapered and often provided with a few spines, and aggregations of minute roundish grains. Ventral pedicels very numerous; dorsal papillæ on crowded warts.

Habitat.—Macassar (Selenka), Mauritius (Haacke).

3. *Deposits—simple rods, or minute* × *-shaped bodies often with the short arms more or less dichotomous and dilated so as to give the aspect of incomplete rosettes.*

Mülleria obesa, Selenka, 1867.

Deposits—finely granulated simple rods.
Habitat.—Sandwich Islands (Selenka).

Mülleria miliaris (*Holothuria*), Quoy and Gaimard, 1833; Brandt, 1835; Selenka, 1867. *Holothuria lineolata*, Guoy and Gaimard, 1833. *Mülleria lineolata*, Brandt, 1835. *Mülleria plebeja*, Selenka, 1867 and 1868.

Deposits—minute rods with the ends slightly dichotomously branched, often presenting themselves under the shape of × or incomplete rosettes. Pedicels forming three more or less distinct series.

Habitat.—Zanzibar (Selenka), Tonga and Vaníkoro (Quoy and Gaimard), Indian Ocean (Ludwig), Nossibé in Madagascar (Ludwig), Mauritius (Haacke, Ludwig), Amboina, Timor and Padang in Sumatra (Ludwig), Mozambique and Querimba (Semper), Red Sea (Ludwig).

(Mus. Holm.) One specimen from Penope and four from the Fiji Islands, all of a dark chocolate-brown colour, with the pedicels in more or less obvious rows. The minute incomplete rosettes are all of the same size, few and scattered and not collected in groups.

Mülleria lecanora, Jæger, 1833; Semper, 1868; Ludwig, 1881. *Holothuria dubia* (subgenus *Microthele*), Brandt, 1835. *Actinopyga lecanora*, Bronn, 1860.

Almost like the preceding species, but the colour on the dorsal surface is always well marked out from that on the ventral, and the anus is always surrounded by a well-defined lighter space.

Habitat.—Philippine Islands (Semper), Celebes (Jæger), Bonin Islands (Brandt), Timor (Ludwig), Mauritius (Haacke, Ludwig).

(Mus. Holm.) One specimen (170 mm. long) from Tongatabu, one from Mauritius, and a third from the Fiji Islands. Dorsal surface uniformly chocolate coloured; ventral surface and a well-defined space round the anus lighter, inclining to yellowish. Pedicels more crowded along the ambulacra, so that an arrangement in three longitudinal series becomes discernible. The dorsal papillæ thinly scattered and small. No supporting rods in the pedicels and papillæ. The incomplete rosettes in the perisome are minute, of nearly equal size, resembling those in the preceding species, but in *Mülleria lecanora* they always seem to be collected in small closely placed groups. The individual dredged at Mauritius has the dorsal surface marbled by means of the small papillæ which are surrounded by a whitish space. There is no doubt that the species in question is very nearly allied to the preceding.

Mülleria echinites, Jæger, 1833; Semper, 1868.

Deposits—small incomplete rosettes, and large simple or irregularly branched rods, having, like the former, the ends of the arms dichotomous.

Habitat.—Indian Ocean (Ludwig), Celebes (Jæger), Padang in Sumatra (Ludwig).

(Mus. Holm.) One specimen from the Fiji Islands. Length, 140 to 150 mm. Colour in alcohol, blackish-brown, with the pedicels, papillæ, and tentacles lighter. Tentacles twenty. Anal teeth of ordinary size. Mouth ventral in position, surrounded by a brim of small papillæ. The ventral cylindrical pedicels very distinctly arranged in three series, though a few pedicels may be found even on the interambulacra. Dorsal papillæ small, not larger than the pedicels, closely placed, and seemingly issuing from minute warts. Deposits crowded, of two kinds —large rod-like bodies, mostly unbranched, or with the ends alone dichotomously branched; and small dichotomously branched incomplete rosettes of the usual shape. There exist great variations in size between these two extremes, but a good many transitional forms may be found among them. The papillæ have very rudimentary terminal plates. The species evidently bears the nearest resemblance to *Mülleria miliaris* and *Mülleria lecanora*.

B. Tentacles twenty-five to twenty-seven.

Mülleria mauritiana (*Holothuria*), Quoy and Gaimard, 1833; Brandt, 1835; Selenka, 1868. *Müllexia varians*, Selenka, 1867.

Tentacles twenty-five. Deposits—in the dorsal integument longer and shorter rods with small processes running out from the sides, and with the ends spinous or more or less distinctly dichotomous; in the ventral perisome small smooth oval grains and larger smooth unbranched rods with the ends slightly rough.

Habitat.—Philippine Islands (Semper), Society Islands (Selenka), Navigator Islands (Semper), Fiji Islands and Sandwich Islands (Selenka), Querimba and Red Sea (Semper), Mauritius (Quoy and Gaimard, Haacke, Ludwig), Amboina, Java, Padang, Pulo Penang (Ludwig), Mozambique, Darros Island, and (?) Amirante Islands (Bell).

(Mus. Holm.) Several individuals from Pulo Penang, Navigator Islands, Fiji Islands, Tahiti, Marquesas, Paumatu, Apia, and Eooa. Tentacles varying from twenty-four to twenty-six. The largest specimen attains a length of 160 mm. Colour auburn, lighter on the ventral surface; white rings surrounding the bases of the papillæ, especially obvious on the sides of the body, and in the neighbourhood of the anus. Pedicels very crowded, not arranged in distinct series. The conical dorsal papillæ are of about the same size as the pedicels. Deposits of the dorsal surface—incomplete rosettes; and numerous elongate rods which are granulated or provided with numerous crowded simple or branched, unequal protuberances. Deposits of the ventral surface—more or less complete rosettes; numerous elliptic bodies which are smooth or provided with incisions; and rods resembling those in the dorsal perisome, but smooth or with less prominent protuberances.

Mülleria agassizii, Selenka, 1867. *Actinopyga agassizii*, Verrill, 1867–1871.

Tentacles twenty-five to twenty-seven. Deposits—in the dorsal perisome minute ×-shaped bodies, in the ventral minute simple rods. Pedicels in three longitudinal series.

Habitat.—Florida, Tortugas and Hayti (Selenka).

Possibly only a variety of the former.

Mülleria guamensis (*Holothuria*), Quoy and Gaimard, 1833; Brandt, 1835.

Habitat.—Guam (Quoy and Gaimard).

Tentacles twenty-six. A very dubious form, which needs re-examination.

Mülleria sp., Walter, 1885.

Habitat.—Ceylon (Walter).

Genus 4. Holothuria, Linné, 1758.

Tentacles twenty, exceptionally more or less. Ambulacral appendages—pedicels alone or papillæ alone, or both papillæ and pedicels; the former placed on the dorsal surface, the latter on the ventral. These ventral pedicels are seldom arranged in longitudinal series. A single bundle of genital tubes situated on the left side of the dorsal mesentery. Anus devoid of calcareous teeth, but sometimes stellate. C-shaped deposits absent.

A. Deposits—more or less incomplete rosettes.

I. Anus more distinctly stellate.

Holothuria marmorata (*Bohadschia*), Jæger, 1833; Semper, 1868; Ludwig, 1881. *Sporadipus ualanensis* (subgenus *Colpochirota*), Brandt, 1835. *Holothuria ualensis*, Selenka, 1867. *Holothuria brandtii*, Selenka, 1867 and 1868. *Holothuria utrimquestigmosa*, Haacke, 1880 (according to Ludwig, 1881).

Habitat.—Philippine Islands (Semper), Nicobar Islands (Semper), Java (Selenka), Celebes (Jæger), Fiji Islands (Semper), Amboina (Ludwig), Geelvink Bay at New Guinea (Ludwig), Mauritius (Haacke and Ludwig), Bonin Islands (Semper), Ualan in Caroline Islands (Brandt).

(Mus. Holm.) One specimen brought home from Mauritius. Length, 120 mm. Colour—dorsal surface auburn, with some large spots or bands of yellowish-white colour, ventral surface yellowish-white; here and there, especially along the sides of the body, a large darker violet spot may be found within a light yellowish space. The ambulacral appendages have the shape of cylindrical pedicels, which, however, are smaller on the dorsal surface.

These pedicels are supported by a well-developed terminal plate and numerous transverse rods. Scattered among the dorsal pedicels other ambulacral appendages may be seen, which, being slightly larger than the dorsal pedicels themselves, present an obvious conical form, and may evidently be regarded as papillæ. These papillæ are supported by a great number of rods, but their terminal plates are very reduced. According to Selenka, the ambulacral appendages are devoid of supporting rods. The rosettes in the body-wall itself are mostly very incompletely developed, either resembling simple × -shaped bodies, or oval grains with incisions at their middle, or rounded grains with or without perforations, or even rods with a series of rounded prominences on each side. A single Polian vesicle and madreporic canal. The anterior portion of the interradial pieces of the calcareous ring is rounded and head-like. Cuvierian organs well developed. Anus stellate owing to five groups of small papillæ, five papillæ in each.

Holothuria argus (*Bohadschia*), Jæger, 1833; Semper, 1868.

Habitat.—Celebes (Jæger), Society Islands (Ludwig), Navigator Islands (Semper), Timor, Waygeou and Padang at Sumatra (Ludwig).

(Mus. Holm.) One specimen from the Fiji Islands. Length, 125 mm. Colour—ventral surface uniformly brown; dorsal surface dark olivaceous, here and there lighter, with numerous large almost black, sharply marked circles. Often two or more circles are united so as to form irregular figures. The circles are always surrounded by a whitish space, measuring about 5 mm. in diameter, and their centre where the papillæ issue is darker than the rest of the space enclosed within them. Though these circles are mainly collected along the sides of the body and on the dorsal ambulacra, they are to be found also in the interambulacra, consequently no distinct longitudinal series are visible. The ventral pedicels seem to be slightly more crowded and larger than the dorsal. In the middle of each "circle" an ambulacral appendage is situated, which has a conical form and bears a rudimentary terminal plate. The pedicels as well as the "papillæ" are strengthened by supporting rods. The anus is not very distinctly stellate. So far as I can find, the differences between this species and the preceding are very unimportant and mainly confined to the colour and the calcareous ring, the latter being many times larger and very solid in *Holothuria marmorata.*

Holothuria vitiensis, Semper, 1868.

Pedicels numerous, equally distributed all over the body. Colour—light brown, darker at the base of the pedicels. Incomplete rosettes like those in the preceding forms.

Habitat.—Nicobar Islands, Navigator Islands, Fiji Islands (Semper).

(Mus. Holm.) Two individuals brought home from the Fiji Islands and New Britain; the former is light greyish or yellowish-brown, with a few larger dark spots or

bands; the latter is of a dark reddish-brown colour and measures about 180 mm. in length. Even here I found among the dorsal pedicels some appendages, which are conical and possess a rudimentary terminal plate. In the specimen from the Fiji Islands the anus is very distinctly stellate. I must confess I cannot distinguish this form from the two preceding ones. They are most probably only varieties of one and the same species.

II. Anus indistinctly or not at all stellate.

Holothuria tenuissima, Semper, 1868.

Anus slightly stellate owing to five groups of papillæ. Pedicels all over the body. Deposits—incomplete rosettes like those in the above mentioned forms; some of them possibly more resembling minute slightly branched rods.

Habitat.—Bohol and Navigator Islands (Semper), Indian Ocean, Timor and Padang (Ludwig).

(Mus. Holm.) One individual agreeing in all respects with the description of Semper. Semper himself says that no other difference exists between this form and *Holothuria vitiensis* than that of the arrangement of the Cuvierian tubes, and he therefore seems very much inclined to refer them to the same species.

Holothuria koellikeri, Semper, 1868.

Habitat.—Navigator Islands (Semper).

Scarcely to be distinguished from the preceding species. The anus does not seem to be stellate.

Holothuria clemens, Ludwig, 1875.

Habitat.—Navigator Islands (Ludwig).

Anus surrounded by fifteen small papillæ. Is scarcely to be distinguished from *Holothuria tenuissima* or *Holothuria koellikeri*, to which forms it bears the nearest resemblance.

Holothuria similis, Semper, 1868.

Habitat.—Bohol (Semper).

According to Semper, fine papillæ exist all over the body. For the rest, I cannot find any character of such importance as to justify its being regarded as a distinct species. I feel almost convinced myself that we have to do with a single species or with a few species capable of great variations, and that most of the above seven species may be justly considered as young or varieties.

B. Deposits—simple or branched rods, the branches being sometimes united, the rods then acquiring the shape of irregular perforated plates.

Holothuria glaberrima, Selenka, 1867.

Ventral pedicels very numerous; dorsal pedicels more thinly scattered. Anus fringed with papillæ. Deposits—minute narrow rods with the ends slightly parted; and minute ×-shaped bodies with the ends of the arms carrying processes.

Habitat.—Hayti, Bahama Islands and Panama (Selenka), Surinam (Semper), Mazatlan (Semper).

Semper refers this species to that group which is characterised by the dorsal ambulacral appendages being transformed into papillæ.

Holothuria lubrica, Selenka, 1867.

Ventral pedicels more numerous than the dorsal "wart-pedicels." Deposits—spinous curved rods.

Habitat.—Acapulco (Selenka), Sanghir (Ludwig), Mazatlan (Semper).

(Mus. Holm.) Numerous specimens brought home from St. Bartholomew, which may be referred to this species or to the preceding one. At the same time it seems very possible that they are identical with Lesueur's *Holothuria obscura*, dredged at the same locality; at least there is nothing which disagrees with the summary description of this author. Colour—dark brown, lighter on the ventral surface; inner surface of the perisome with blackish spots. Anus fringed with small elongate papillæ. The ventral pedicels much more crowded than the dorsal, whereby a line of demarcation becomes visible on the transition between the two surfaces. Very often a narrow naked space is to be seen along the odd ambulacrum, separating the ventral pedicels into two longitudinal series. It seems somewhat uncertain whether the dorsal appendages are to be regarded as papillæ or pedicels; like the ventral ones, they have a distinct, though smaller sucking-disk and a well-developed terminal plate. In some individuals they are more obviously cylindrical than in others, and in the very same specimen some are cylindrical others more elongate conical, with smaller sucking-disk. The dorsal sucking-disks are dark, while the larger ventral ones are pale. With regard to the calcareous ring, deposits, Polian vesicles, and madreporic canals, the specimens from St. Bartholomew closely resemble *Holothuria lubrica*. The calcareous rods have a more or less rough surface, are often not very distinctly curved, and have the ends slightly spinous. In the larger specimens some Cuvierian tubes are present.

Holothuria moebii, Ludwig, 1883.

Ventral pedicels more numerous than the dorsal papillæ. Deposits—numerous finely granulated rods, and, besides, in the ventral perisome quite smooth rods.

Habitat.—Hong Kong (Ludwig).

Nearly allied to the preceding species, but differing from it in the structure of the rods as well as by the presence of H-shaped supporting rods in the ventral pedicels.

(Mus. Holm.) One individual brought home from Mauritius.

Holothuria erinaceus, Semper, 1868. *Holothuria erinaceus*, var. *pygmæa*, Semper, 188.

Ventral pedicels numerous; dorsal papillæ fine and even closely placed. Deposits—numerous rods provided with spines or prominences and slightly branched at the ends.

Habitat.—Bohol and Luzon (Semper), Fiji Islands (Semper), Port Mackay (Semper).

Semper supposes the species to be very nearly related to *Holothuria glaberrima* and possibly identical with it. He even speaks of some young, which are said to have the ventral pedicels disposed in more or less distinct rows, and possess tables besides the rods, which tables vanish as the individual grows larger. It seems more probable that these "young" belong to another species.

(Mus. Holm.) Two specimens obtained at the Fiji Islands, the largest 200 mm. long, of a dark brown colour inclining to blackish; ventral surface lighter; pedicels light yellowish-brown. The dorsal papillæ small, not so crowded as the pedicels. The calcareous rods bear a few spines on their sides, and their ends are slightly branched or perforated. Excepting terminal plates, no other deposits.

Holothuria paradoxa, Selenka, 1867.

Ventral pedicels more numerous than the dorsal, which may be of the same kind. Deposits—in the ventral perisome smooth rods and × -shaped bodies, the arms of the latter being branched and often united so that the bodies take the shape of small perforated plates; in the dorsum more finely constructed × -shaped bodies alone are to be found.

Habitat.—Sandwich Islands (Selenka).

Doubtless closely allied to *Holothuria glaberrima*, from which it differs in some characters of more or less importance. Thus, the madreporic canal is free in *Holothuria glaberrima* but attached in *Holothuria paradoxa*; in the former the

radial pieces of the calcareous ring are more than twice as large as the interradial, while in the latter they are of nearly equal size. Even the deposits in the body-wall present some small differences.

Holothuria marenzelleri, Ludwig, 1883.

Ventral pedicels more numerous and with larger disks than the dorsal, which on the other hand run out from slightly larger warts than the former. Deposits—flat rods with short, mostly dichotomous branches in the margin, these branches being sometimes united so as to form holes, the rods themselves thus acquiring the aspect of irregular plates with the margin uneven or spinous and perforated by two to six or more asymmetrical holes.

Habitat.—Nangkauri (Ludwig).

(Mus. Holm.) One individual from Nangkauri, agreeing in all respects with the description of Ludwig. It is, however, impossible to distinguish any arrangement of the ventral pedicels in rows—as stated by Ludwig—nor whether they are placed on low warts, which, on the contrary, is the case with the dorsal. All the pedicels, being true pedicels, are exactly like one another, excepting that the dorsal have a smaller disk and are possibly slightly conical. Anus fringed with small fine papillæ.

C. Deposits—tables alone in a higher or lower state of development.

I. Tables incomplete, either the spire or the disk being absent or highly reduced.

Holothuria catanensis, Grube, 1840, 1864; Semper, 1868; Heller, 1868.

Dorsal papillæ small, indistinctly disposed in seven irregular rows. Ventral pedicels indistinctly arranged in three longitudinal series. Deposits—very small and thinly scattered, rounded disks of tables alone, pierced with four holes; the spire is absent or rudimentary.

Habitat.—Mediterranean Sea (Grube, Heller, von Marenzeller, Græffe, Ludwig), Portinho (Greeff).

Von Marenzeller kindly sent me three specimens dredged at Lesina. Two are blackish-brown, the remaining one is lighter. The dorsal papillæ seem to be situated on low warts, and do not present any arrangement in rows. The minute and very thinly scattered disks of the tables often carry four short spines, showing traces of a spire. The pedicels have a large terminal plate surrounded by a few slender, slightly spinous rods, with the ends dilated and perforated; besides which, the "disks" are more frequent in the pedicels than in the body-wall itself. The papillæ are supported by a very rudimentary terminal plate and numerous crowded, solid, and nearly smooth rods with the ends spinous, or branched, or perforated. In the papillæ I have found disks with nearly complete spires.

Holothuria languens, Selenka, 1867.

Pedicels all over the body. Tables consisting of a spire alone, built up of four rods and one transverse beam; the spire bears spines at the annular base and round the truncated top.

Habitat.—Panama (Selenka), Surinam and British Guiana (Semper).

Holothuria dietrichii, Ludwig, 1875.

Pedicels all over the body. The oval or rounded smooth disks of the tables are regularly perforated with four holes, and support a spire reduced to two rods anastomosing near the free ends.

Habitat.—Bowen and Hong Kong (Ludwig).

The tentacles, calcareous ring, &c., were destroyed in the specimens examined by Ludwig.

II. Tables complete, but with the disks small, annular and spinous in the margin.

Holothuria pertinax, Ludwig, 1875.

The ventral pedicels forming a simple row along each side and a double one along the middle. Dorsal papillæ irregularly scattered. Tables equally broad and high; the short spire is made up of four rods and one transverse beam, and its truncated top terminates in teeth.

Habitat.—Navigator Islands (Ludwig).

Even the calcareous ring is of uncommon construction, its interradial pieces being transformed into very slender narrow curved bands, much longer than the radial.

Holothuria imitans, Ludwig, 1875.

Ventral pedicels and dorsal papillæ scattered. The elongate spire built up of four rods and one transverse beam, with the rounded top carrying spines or teeth.

Habitat.—Navigator Islands (Ludwig).

III. Tables complete, made up of a smooth, usually well-developed, perforated disk supporting a distinct spire.

Holothuria modesta, Ludwig, 1875.

Papillæ all over the body. The roundish smooth disk of the tables is pierced with about eight holes, and carries a long conical spire made up of four rods and several—about four—transverse beams; the top of the spire terminating in several teeth.

Habitat.—Cape York (Ludwig), (?) Torres Strait (Bell).

According to Ludwig, like *Holothuria martensii* in internal and external organisation.

Holothuria intestinalis, Ascanius and Rathke, 1767; Düben and Koren, 1844. *Thyonidium scabrum*, Sars, 1868 (according to O. Sars, 1871). *Holothuria mollis*, Sars, 1835.

Pedicels alone. The tables are very regularly formed, consisting of a circular disk with smooth though undulated margin, and pierced with a large central hole surrounded by a simple or double circle of smaller peripheric holes; the spire is built up of four rods and one transverse beam, and terminates in sixteen or more teeth.

Habitat.—Scandinavia from the Sound to Finmark (Düben and Koren, Danielssen and Koren, Möbius and Bütschli, Ludwig, Sars), White Sea (Jarzynsky), British Islands (Forbes and Goodsir).

(Mus. Holm.) A great number of specimens from different localities of Scandinavia. I am inclined to regard all the ambulacral appendages as pedicels. They are cylindrical or conico-cylindrical, with sucking-disks and terminal plates, but devoid of supporting rods. Along the sides of the body they are longest, 7 to 8 mm., but decrease towards the middle of the back in a more or less obvious manner. On the ventral surface, on the contrary, the pedicels are scattered and very minute, nearly inconspicuous, and reduced, apparently, to a disk with distinct terminal plate. To judge from the description of Düben and Koren, they must have confounded the dorsal and ventral surfaces.

Holothuria magellani, Ludwig, 1883.

Habitat.—Strait of Magellan (Ludwig).

This species is doubtless very nearly related to the preceding one, and it seems almost impossible to point out any distinguishing character of importance. According to Ludwig, the odd ambulacrum is almost devoid of pedicels, and the dorsal surface carries thinly scattered small "papillæ," while the lateral ventral ambulacra have a double row of well-developed pedicels.

D. Deposits—tables in a higher or lower state of development, in company with simple or branched rods or fenestrated more or less irregular plates.

I. Tables very much transformed, devoid of disks, and with a long irregular spire of a more uncommon shape.

Holothuria gräffei, Semper, 1868.

Ventral pedicels in three distinct longitudinal series. Dorsal papillæ large, scattered. Deposits—besides tables, rosettes and irregularly branched, plate-like bodies. Tentacles twenty-four to twenty-five.

Habitat.—Philippine Islands, Molucca Islands, and Fiji Islands (Semper), Timor (Ludwig).

The description of the tables and the figures given by Semper are not fully comprehensible. The species is characterised by having more than twenty tentacles.

II. Tables of a more common shape, with the disk mostly small, annular, or completely reduced, and with a spire built up of four rods and one transverse beam.

1. *In addition to tables with completely reduced disks, large characteristic unbranched bars, more or less richly covered with protuberances or small elevations.*

Holothuria flavo-maculata, Semper, 1868.

Ambulacral appendages—pedicels alone. Only the spire of the tables is left. The four rods which constitute the spire are united at the base so as to form a rounded conical top instead of a disk; near this top each rod seems to bear a small spine. The opposite ends of the rods, which form the truncated outwardly directed part of the spire, terminate each in four diverging teeth. The bars are large, elongate, fusiform, thick at the middle, and rough from numerous small protuberances.

Habitat.—Navigator Islands (Semper).

A comparison of the above description of the tables with the figure drawn by Semper suggests the idea that Semper saw the tables with the upper part undermost, a supposition founded on reasons given under the next species. Possibly the same is the case with Ludwig's *Holothuria imitans*, which agrees in most respects with this species, but differs from it in having the characteristic rough bars only present in the ambulacral appendages.

Holothuria surinamensis, Ludwig, 1875.

Ventral pedicels more numerous than the dorsal papillæ. Deposits almost like those in the preceding species.

Habitat.—Surinam (Ludwig).

When comparing the descriptions of Semper and Ludwig, one can scarcely detect any characters to distinguish this species from the preceding, except differences in the ambulacral appendages and number of madreporic canals and Polian vesicles. As will be seen below, there exist, however, some differences even in the shape of the calcareous bars. Since I have had the opportunity of examining four specimens of *Holothuria surinamensis* dredged at Mexico, and kept in the Zoological State Museum at Stockholm, I am able to complete the description of Ludwig. The largest specimen attains a length of 200 mm., and agrees in all respects with Ludwig's types. Colour—dark rusty-brown, inclining to greyish on the ventral surface; ends of the pedicels whitish; papillæ and a small space round their base light yellowish rusty-brown; numerous well marked dark brown spots on the back. Anus with five not very distinct groups of papillæ. The numerous tables bear the closest resemblance to those figured by Ludwig as well as to those in *Holothuria flavo-maculata*, but Ludwig, and

almost certainly Semper also, have drawn the tables with the spinous truncated end downwards, supposing the conical top, which carries a few minute spines, or none, to be directed outwards from the skin. This may, however, be wrong. The tables are totally destitute of disks, the four rods being bent inwards and united at the pointed or rounded base; near the base, each of the four rods constituting the spire often carries a small spine. At the middle the spire has a transverse beam, and its outwardly directed, truncated top bears eight to twelve double teeth. Supposing that even Semper is mistaken when he states the spinous ends to be the disks of the tables, there is evidently the greatest conformity in the tables of the two species in question. With regard to the bars, on the contrary, there exist some small differences. Those in *Holothuria surinamensis* are even elongate and of solid construction, but carry along each side only a series of processes, which often become combined with each other towards the ends of the bars, so as to form some small holes on each side; these bars often bear near their extremities some minute rough elevations on their upper and under surfaces, but, for the rest, they seem to be quite smooth. Even the pedicels and papillæ are supported by such bars, which are slightly stronger and have the processes more commonly united with each other, thus forming more perforations than in the bars of the body-wall itself.

Holothuria fusco-coerulea, n. sp.

Ventral pedicels and dorsal papillæ. Deposits like those in *Holothuria flavo-maculata* above described. Tentacles twenty-nine.

Habitat.—Tahiti (Mus. Holm.).

The species is certainly closely allied to *Holothuria flavo-maculata*, but is distinguished by the uncommon number of tentacles and the shape of the ambulacral appendages. Body cylindrical. Anus round, with five pairs of small papillæ. The ambulacral appendages are small, of almost equal size, and more thinly scattered; the dorsal ones are obviously of a conical form, while the ventral are cylindrical. Anteriorly, and still more posteriorly on the ventral surface, conical papillæ are placed. The tentacles are surrounded by a brim of papillæ. The figure drawn by Semper, turned upside down, gives a very correct idea of the shape of the tables. The elongate, cylindrical or fusiform, densely knobbed or spinous bars closely resemble those in Semper's species. The conical papillæ are strengthened by a very rudimentary terminal plate and some slightly curved and spinous rods, which sometimes have the ends slightly branched or perforated. The pedicels possess a comparatively large terminal plate, and a number of irregularly perforated elongate plates. Besides these deposits, the pedicels and papillæ contain numerous crowded tables and spinous rods of the same kind as those in the body-wall itself. There are two long slender Polian vesicles and three madreporic canals. Colour—blackish, inclining to bluish tentacles light brownish or yellowish; pedicels and papillæ yellowish-brown.

2. *In addition to tables with a simple annular disk or with a more or less well-developed perforated one, simple or branched rods but no plates.*

Holothuria tremula, Gunner, 1767; Düben and Koren, 1844; Selenka, 1867. *Holothuria elegans*, O. F. Müller, 1788–1806: · *Fistularia elegans*, Lamarck, 1815 1822. *Holothuria* (subgenus *Thelenota*) *elegans*, Brandt, 1835.

The dorsal papillæ are conical, while the ventral have a more cylindrical or conico-cylindrical appearance. Disks of the tables well developed, rarely or never smooth on the margin, but mostly spinous or angular, and pierced with a varying number of rather large angular holes; the spire terminates in numerous teeth arranged in two crowns. The rods are of two kinds—solid, simple or branched, more or less spinous; and delicate, slender, spinous branched ones.

Habitat.—Coast of Scandinavia, from the Cattegat to Drontheim (Sars, Düben and Koren, Danielssen and Koren, O. F. Müller, Ludwig, Möbius and Bütschli), between Norway and Shetland (Hoffmann), Bay of Biscay (Norman).

(Mus. Holm.) A very great number of specimens from Sweden and Norway. The red colour vanishes in alcohol, but the minute dark dots remain especially on the dorsal surface. Mouth surrounded by a distinct crown of papillæ arranged in about two circles. The dorsal conical papillæ have broad bases. The ventral cylindrical appendages have distinct sucking-disks and terminal plates, much larger than those of the dorsal papillæ, and they may be regarded as pedicels rather than as true papillæ. Sometimes they are more closely placed on the three ventral ambulacra, and sometimes they seem to be smaller on the odd ambulacrum. The tables do not at all resemble the figure drawn by Selenka, but the drawings of Düben and Koren give a better idea of their true shape. The perforated disks are very delicate, and the numerous teeth on the top of the spire form two crowns, the lower of which is situated just at the transverse beam, and contains eight to twelve teeth; the higher placed crown, forming the top itself of the spire, has about sixteen teeth or more. The simple or branched rods are not equally distributed all over the body; they seem always to be present in the neighbourhood of the ambulacral appendages.

Holothuria pulchella, Selenka, 1867; Ludwig, 1881. *Stichopus* (subgenus *Gymnochirota*) *cinerascens*, Brandt, 1835.

The ventral pedicels are much more crowded than the small dorsal papillæ. The spire of the tables is supported by a reduced almost annular disk, and carries twelve teeth on the top. The rods are slightly curved and finely granulated.

Habitat.—Sandwich Islands (Selenka), Philippine Islands (Semper), Sunda Islands and Java (Semper), Mozambique (Semper), Tahiti, Batjan, and Navigator Islands (Semper), Boninsima (Brandt), Enosima (von Marenzeller), Mauritius (Haacke, Ludwig).

(Mus. Holm.) Four specimens from Tahiti and one from Marquesas, agreeing in all respects with the description of Selenka. The rods are very characteristic, commonly more or less curved and finely granulated, often with the ends more rough and slightly branched. Even the supporting rods of the pedicels and papillæ are of the same kind. The number of Polian vesicles and madreporic canals is very variable; thus I counted in one specimen as many as eleven Polian vesicles and two free madreporic canals, and in another three to four madreporic canals in a bundle.

Holothuria pervicax, Selenka, 1867; Ludwig, 1883. *Holothuria depressa*, Ludwig, 1875. *Holothuria mammiculata*, Haacke, 1880.

The ventral pedicels are more crowded than the dorsal papillæ. The tables are not very well developed, their spire being often more or less reduced, short, and terminating in four simple teeth; the disks are small, rounded, smooth or slightly uneven on the margin. The small, more or less elongate rods are characterised by being uneven and warted, or distinctly undulated, or deeply incised so as to form a row of loops or holes along each side.

Habitat.—Tahiti, Pelew Islands, and Philippine Islands (Ludwig), Sandwich Islands (Selenka), Zanzibar (Selenka), Mauritius (Haacke, Ludwig), Australia, Red Sea, and Navigator Islands (Semper).

(Mus. Holm.) One specimen, 70 mm. long, from the Navigator Islands. Colour in alcohol, greyish-brown with some darker transverse bands on the back. The pedicels and papillæ are of about the same size. The tables have often a rudimentary spire. The rods present examples of transitional forms between simple rods and "buttons." Pedicels and papillæ with numerous, slightly curved rods provided with spines. These rods have often a complete or incomplete series of holes along one or both sides, or only at the ends. Terminal plates of the papillæ very rudimentary.

3. *In addition to tables with a small annular disk or with a slightly more developed perforated one, fenestrated plates mostly of irregular shape.*

Holothuria atra, Jæger, 1833; Semper, 1868; Ludwig, 1881. *Holothuria* (subgenus *Microthele*) *affinis*, Brandt, 1835. *Holothuria floridana*, Pourtalès, 1851; Selenka, 1867. (?) *Holothuria radackensis*, Chamisso and Eysenhardt, 1821.

The dorsal papillæ and ventral pedicels of nearly equal size. Disks of the tables forming a simple ring, often with a small hole at the base of each vertical rod; spire terminating in eight horizontal and four vertical, rather long teeth. The small fenestrated plates are evenly rounded or undulated on the margin; they are often undeveloped, ×-shaped with the arms slightly branched.

Habitat.—Celebes (Jæger), Florida (Pourtalès, Selenka), Zanzibar, Java (Selenka),

Madagascar (Ludwig), Djedda, Red Sea and Indian Ocean (Ludwig), Querimba, Red Sea (Semper), Ualan (Brandt), (?) Radack Islands (Chamisso and Eysenhardt), Sandwich Islands and Society Islands (Selenka), Philippine Islands, Navigator Islands, Fiji Islands, Nicobar Islands, Amboina, Batchian, Molucca Islands (Semper), Macassar, Timor, Padang, and Pulo Tibul (Ludwig), Havana, Jamaica, and Tahiti (Ludwig), Darros Island (Bell).

Mus. Holm.) Several specimens from Tonga, Fiji Islands, and Penope. As a rule the specimens are supported by tables, which have the small annular disk smooth, but I even found, not unfrequently in the very same specimen, disks with spines on the margin.

Holothuria atra, var. *amboinensis*. *Holothuria atra*, Selenka, 1867. *Holothuria amboinensis*, Semper, 1868.

Habitat.—Amboina (Selenka), Puerto Cabello in Venezuela (Ludwig), Mozambique (Bell).

This form is scarcely distinct from the preceding species, from which it differs mainly in the fact that the annular disk bears spines; but even *Holothuria atra* has sometimes such spines.

(Mus. Holm.) One specimen, 350 mm. long, from Tonga exactly resembles *Holothuria coluber* of Semper in external appearance. Colour almost black; tentacles, pedicels, and papillæ light yellowish-brown. Four slender Polian vesicles and a single madreporic canal with elongate bipartite tubercle. Calcareous ring of the usual shape and size. Disks of the tables slightly better developed than in Selenka's *Holothuria atra*, and with larger spines on the margin; the spire with eight to twelve teeth at the top.

Holothuria pulla, Selenka, 1867; Ludwig, 1881. (?) *Holothuria* (subgenus *Microthele*) *æthiops*, Brandt, 1835.

Habitat.—Amboina (Selenka), Ualan (Brandt), (?) Ugi Australia, and (?) Mozambique (Bell).

Almost completely like *Holothuria atra;* differs from it by possessing Cuvierian tubes, a character of very subordinate importance considering the well-known fact that individuals of the very same species vary greatly in this respect.

Holothuria grisea, Selenka, 1867.

Habitat.—Hayti (Selenka), Surinam and Rio Janeiro (Semper), St. Thomé and Rolas (Greeff), Brazil (Ludwig).

Differs from *Holothuria atra* principally in the fact that the fenestrated plates are collected in circles in the integument.

(Mus. Holm.) One specimen from Brazil. Length, 135 mm. Tentacles twenty-one, the ventral slightly smaller. Ventral pedicels more densely crowded than the dorsal papillæ, which are placed on low warts. Colour in

alcohol, greyish-brown, speckled with light grey; ventral surface lighter, and pedicels yellowish-brown. Three Polian vesicles and a single free, slender madreporic canal, 20 mm. in length. The interradial pieces of the calcareous ring are comparatively narrow. The scattered tables have their disks reduced to a simple ring, which, however, contrary to what is indicated in the figure given by Selenka, is often provided with spines; their spire terminates in twelve large teeth. The circles of small fenestrated plates present themselves to the naked eye as very minute white spots. The papillæ have a very rudimentary terminal plate and slightly curved, almost smooth rods, with the ends enlarged and perforated. Excepting a well-developed terminal plate, the pedicels contain very few such rods, which sometimes are transformed into perforated plates.

Holothuria pyxis, Selenka, 1867.

Pedicels (=papillæ?) equally distributed all over the body, situated on conical warts. The disks of the tables more developed than in the preceding forms, with about twelve teeth or spines on the margin, arranged in groups of three, and with a peripheral circle of holes round the centre; the spire terminates in twelve teeth. The fenestrated plates like those in the preceding forms, but not collected in circles.

Habitat.—Java (Selenka).

Holothuria inornata, Semper, 1868.

Dorsal surface with papillæ; ventral surface with pedicels. Deposits entirely like those in *Holothuria pyxis*.

Habitat.—Mazatlan (Semper).

I am much inclined to consider the two latter forms as being very nearly related to one another, as well as to *Holothuria atra*, &c., though it may be observed that *Holothuria pyxis* differs from all the rest by its uniform papilla-like ambulacral appendages.

Holothuria mexicana, Ludwig, 1875.

Pedicels scattered all over the body. Deposits resembling those in *Holothuria atra*, though the fenestrated plates are more symmetrical and regularly formed.

Habitat.—Mexico (Ludwig).

(Mus. Holm.) Two specimens, one 200 mm. long, dredged at St. Bartholomew, and the other, 230 mm. long, brought home from Guadaloupe. Colour—dirty yellowish-grey, slightly darker on the back, which is marked with dark brown irregular spots. The brown pedicels are equally large and uniformly distributed. Body-wall thick, leathery. Of the crowded plates two types may be observed, one more rounded, pierced with minute and commonly more numerous holes; and the other irregularly rectangular, with fewer and larger holes. Two bundles of numerous madreporic canals (as many as twenty), with pear-shaped ends

and several long Polian vesicles. The specimen obtained at Guadaloupe differs slightly, and forms a transition to *Holothuria atra*, to which both specimens bear a great resemblance. The dorsal surface of this specimen is uniformly dark brown. The ventral surface is light yellowish-grey, with a broad longitudinal brown band along the odd ambulacrum; ventral pedicels dark brown at the base. Anus with five minute groups of papillæ. Among the dorsal slightly smaller pedicels, which, like the ventral ones, are destitute of supporting rods round the terminal plate, some appendages may be found which have a conical form and a small terminal plate surrounded by some rather strongly-formed supporting rods.

Holothuria edulis, Lesson, 1830; Semper, 1868. *Trepang edulis*, Jæger, 1833. *Holothuria fusco-cinerea*, Selenka, 1867.

Dorsal papillæ minute, and more scattered than the ventral pedicels. The disks of the tables reduced to a small ring, narrower than the top of the spire, which, seen from above, presents a small circular hole surrounded by four prominences, each with about four or five minute teeth. The fenestrated plates nearly like those in *Holothuria grisea*.

Habitat.—Philippine Islands (Semper, Lesson), Mozambique (Semper), Molucca Islands (Lesson), Amboina (Selenka, Ludwig), New Holland and Caroline Islands (Lesson), Aden (Semper), Celebes (Selenka, Ludwig), Java and Timor (Ludwig).

(Mus. Holm.) One specimen, 250 mm. long, from the Fiji Islands, and a smaller one from New Britain. Colour—dark reddish-brown on the back, light greyish on the ventral surface and the sides; a minute dark ring round the base of the light pedicels. The dorsal papillæ are very minute. A single Polian vesicle. A small bundle of about four minute, free, madreporic canals on each side of the dorsal mesentery. The base of the tables always narrower than the top. The small fenestrated plates often incomplete, resembling ×-shaped spicules. The species is doubtless nearly allied to *Holothuria atra*, but seems to be well defined by the colour, the shape of the tables, &c.

4. *In addition to tables with a small annular disk, finely granulated perforated plates with the holes arranged in two longitudinal series.*

Holothuria unicolor, Selenka, 1867.

The ventral pedicels much more numerous than the dorsal. Tables like those in *Holothuria atra* and *Holothuria mexicana*. The plates are finely granulated, slightly irregularly formed, with smooth margins and numerous holes arranged in two series, each series composed of about two irregular rows.

Habitat.—Barbados (Selenka).

Semper refers this species to the group, which is characterised by papillæ on the dorsal surface. It bears the nearest resemblance to *Holothuria mexicana* or *Holothuria atra*.

E. Deposits—Tables together with Buttons.

I. Ambulacral appendages—pedicels alone; or pedicels on the ventral surface and papillæ on the dorsal, the latter being often very like the former.

1. *Buttons smooth, oval or elongate, nearly always with three pairs of holes, exceptionally with more or fewer. Spire of the tables as a rule made up of four rods and one transverse beam; exceptionally more rods and beams present.*

a. Disks of the tables smooth, without spines on the margin. Number of tentacles typical, twenty.

(1) *Ventral pedicels arranged in three more or less distinct longitudinal series.*

Holothuria monacaria (*Psolus*), Lesson, 1830; Jæger, 1833. *Holothuria flammea*, Quoy and Gaimard, 1833. *Holothuria fusco-punctata*, Quoy and Gaimard, 1833. *Holothuria fasciola*, Quoy and Gaimard, 1833. *Stichopus flammeus*, Brandt, 1835. *Stichopus gyrifer*, Selenka, 1867 and 1868. *Labidodemas leucopus*, Haacke, 1880 (according to Ludwig, 1883).

The dorsal papillæ arranged in four indistinct longitudinal rows. The rounded disk of the tables with a central hole surrounded by from four to twelve peripheral holes. The spire terminates in about twelve teeth or more. The oval smooth symmetrical buttons with three or four pairs of holes.

Habitat.—Zanzibar (Selenka), Querimba (Semper), Mauritius (Haacke, Ludwig), Nicobar Islands, Philippine Islands, Navigator Islands, Pulo Tikul, and Amboina (Semper), Sandwich Islands (Selenka), Society Islands (Semper, Selenka, Lesson), New Ireland and Vanikoro (Quoy and Gaimard), Australia (Selenka, Semper), Waygeeoo (Ludwig), Celebes (Ludwig), Molucca Islands (Semper), Borabora (Lesson).

(Mus. Holm.) Two specimens from unknown locality, and one 110 mm. long from Pelew Islands. Professor Möbius of Kiel has also kindly sent me a small specimen, about 45 mm. long, dredged at Mauritius. In the small specimen from Mauritius, which is probably young, the pedicels are placed in three double or alternating rows on the ventral surface, an arrangement which is not so distinct in the remaining forms. Even the small dorsal papillæ do not always seem to be placed in very distinct rows. Colour of the smaller specimen—auburn, with the ventral surface, the papillæ, and a space round them paler. The large specimen from Pelew is dirty yellowish-white, speckled with brown or greenish-brown on the back. Mouth surrounded by some small papillæ. The disks of the tables are slightly undulated on the margin. The symmetrical or slightly-

asymmetrical buttons have very often more than six holes, though this number is the most common. The papillæ have a very rudimentary terminal plate, and curved, rod-like, perforated deposits. Besides, both pedicels and papillæ contain numerous crowded buttons and tables, and near the end bilateral perforated plates.

Holothuria decorata, von Marenzeller, 1881. *Labidodemas neglectum*, Haacke, 1880 (according to Ludwig, 1883).

Habitat.—Japan (von Marenzeller, Ludwig), Mauritius (Haacke, Ludwig).

According to Ludwig, this is probably the young of the former, and, indeed, there do not seem to be any distinguishing characters of sufficient importance to justify its reception as a new species. Some of the tables have as many as three transverse beams in the spire, and the buttons have generally eight holes.

Holothuria macleari, Bell, 1884.

Habitat.—Clairmont and Bird Islands in North-East Australia (Bell), Island of Rodriguez (Bell).

Bell says: "As will be seen from the figures, the spicules of this species present a considerable resemblance to those of *Holothuria tigris*, with which, as it would seem, it must be closely allied." The pedicels, however, form three longitudinal rows, the dorsal surface has papillæ, and, finally, the figured deposits seem to bear as great a resemblance to those of *Holothuria monacaria* as to those of any other form. A re-examination is necessary.

(2) *Ventral pedicels not arranged in longitudinal series.*

Holothuria humilis, Selenka, 1867.

Ambulacral appendages—pedicels. The tables with not very large disks, and with the spire terminating in eight teeth. Buttons very flat, of usual shape. All the pedicels with supporting rods, but the ventral alone possessing terminal plates. Calcareous ring very small and of uncommon shape, its ten pieces being very small, round, and brown.

Habitat.—Sandwich Islands (Selenka).

Distinguishable from the following species mainly by the peculiar calcareous ring which is unlike that of any other Holothurian.

Holothuria vagabunda, Selenka, 1867; Semper, 1868. *Stichopus* (subgenus *Gymnochirota*) *leucospilota*, Brandt, 1835 (according to Ludwig, 1881).

Ambulacral appendages—pedicels. The tables with not very large disk and with the spire terminating in eight to ten teeth, placed round the nearly circular aperture

in its top. Buttons of the usual shape with six holes. The dorsal pedicels alone have supporting rods which are spinous and tapered towards the ends.

Habitat.—Sandwich Islands and Society Islands (Selenka), Philippine Islands, MacKean's Islands, Sunda Islands, Mozambique and Aden (Semper), Zanzibar (Selenka), Java (Selenka, Ludwig), Navigator Islands (Semper, Ludwig), Nicobar Islands and Hong Kong (Ludwig), Darros Island (Bell), Ualan (Brandt), Bowen (Ludwig).

(Mus. Holm.) Two specimens from Navigator Islands, one from Port Dennor and one from Peru. Moreover, the Godeffroy Museum has specimens from the following localities: Tahiti, Massua, Ecoa, Fiji Islands, Rockhampton, and New Britain. In all these specimens the ambulacral appendages appear to be of nearly equal size on the dorsal and ventral surfaces; but, at the same time, I always found the ventral ones cylindrical, and the dorsal, on the contrary, more papilliform. The ventral have a well-developed terminal plate and bilaterally symmetrical, perforated supporting plates; the dorsal have a rudimentary terminal plate and numerous simple spinous or slightly branched or even perforated rods. Besides, the ventral appendages are always more numerous than the dorsal. Thus the forms examined by me apparently present examples of dorsal appendages forming a transition between pedicels and true papillæ, and show that it is rather difficult to draw a line of demarcation between them. That the forms I have seen really belong to this species is proved by the whole internal and external organisation. The colour varies from dark brown to light reddish-brown. A single Polian vesicle and madreporic canal are present. The genital tubes are slender, and slightly dichotomously branched. The strongly-developed Cuvierian tubes are of a violet or reddish-colour. The disks of the tables are sometimes not very well developed, sometimes round or angular, with a large central hole, and several peripheral ones, and their margin is often uneven.

Holothuria lagæna, Haacke, 1880; Ludwig, 1883.

Habitat.—Mauritius (Haacke, Ludwig), Mozambique (Bell).

(Mus. Holm.) One specimen from Mauritius presented by Professor Möbius. From the description of Ludwig as well as from my own researches, I cannot find any other character distinguishing this form from the true *Holothuria vagabunda*, than the fact that it has "papillæ" instead of pedicels on the back; but even in the later species the dorsal appendages present a great resemblance to "papillæ," and I am therefore much inclined to annul this species. A re-examination and comparison of both forms will therefore be necessary.

Holothuria difficilis, Semper, 1868. *Müllerica parvula*, Haacke, 1880 (according to Ludwig, 1883).

The dorsal papillæ very thinly scattered. Ventral surface with pedicels. The disks of the tables well developed, with numerous peripheral holes, and the spire

terminating in four groups of teeth, each group composed of several (five to seven) teeth. Buttons large, of normal shape, slightly asymmetrical.

Habitat.—Navigator Islands (Semper), Mauritius (Haacke, Ludwig).

Differs from *Holothuria vagabunda* mainly in the shape of the tables.

Holothuria strigosa, Selenka, 1867.

Pedicels all over the body. Tables like those of *Holothuria vagabunda*. Buttons of two kinds—in the dorsal perisome symmetrical smaller ones like those in the above mentioned species; in the ventral, on the contrary, more elongate, robust, irregular ones, with as many as twelve minute holes. In the neighbourhood of the pedicels much larger buttons may be found.

Habitat.—Zanzibar (Selenka), Red Sea (Ludwig).

Holothuria farcimen, Selenka, 1867.

Ventral surface with numerous pedicels; dorsal surface with thinly scattered papillæ. The solid tables bear four groups of five teeth each on their top. Buttons mostly with five pairs of holes.

Habitat.—Azores Islands (Selenka).

The species seems to bear the nearest resemblance to *Holothuria difficilis*.

Holothuria captiva, Ludwig, 1875.

Ventral surface with numerous pedicels; dorsal surface with thinly scattered papillæ. Disks of the tables well developed, and spire terminating in a great number of teeth. Buttons of common shape, though slightly asymmetrical.

Habitat.—Barbados (Ludwig).

Differs from *Holothuria difficilis* by possessing a smaller calcareous ring and by the great number of teeth on the rounded top of the spire.

(Mus. Hohn.) Numerous specimens from Bartholomew. The deposits are comparatively large. There are twenty or more teeth on the rounded top of the spire, but there are tables with even fewer teeth, in which case the top of the spire is truncated, not rounded. The buttons are large, elongate, fusiform, more or less obviously curved; the regularly formed ones have six holes, but I have seen buttons with even more holes, or with only two, three, or four. Sometimes buttons devoid of holes may be found. As a rule, they are thickest along the middle line. The pedicels have perforated plates round the well-developed terminal plate; the papillæ have also such plates, as well as strong curved rods. Numerous Cuvierian tubes are present. Colour in alcohol, light brown.

Holothuria curiosa, Ludwig, 1875.

Ventral surface with pedicels; dorsal surface with papillæ. Tables of varying size; in the larger the disk supports a rudimentary spire composed of four short

rods and one transverse beam, the four rods not being combined—as is usual —at the top, but terminating each in a simple point; the smaller tables have the spire reduced to one or two spines. Buttons oval, commonly less developed, and only pierced with two elongate openings.

Habitat.—Bowen (Ludwig).

(Mus. Holm.) One specimen from the Fiji Islands. Length, 180 mm. Colour in alcohol, light dirty greenish inclining to brownish or yellowish; the base of the pedicels and papillæ surrounded by a dark brown ring; tentacles yellowish. Anus with five groups of papillæ. The ventral pedicels of about the same size as the papillæ, and only a little more closely placed. A single Polian vesicle and madreporic canal. Calcareous ring agreeing with the figure given by Ludwig. Cuvierian organs strongly developed. The usually very incomplete tables consist of a small irregular disk pierced with a few holes, and supporting a spire reduced to a single spine. In the pedicels and papillæ the tables are more highly developed, having larger disks and a long spire built up of four rods and from one to five transverse beams; these spires terminate in four simple points. Ludwig does not mention anything about the presence of such tables; they possibly escaped his attention, otherwise the form examined by me is a new species, which, considering the very obvious resemblance, does not seem probable. The buttons are small and undeveloped in the body-wall itself, but in the ambulacral appendages they become larger, with six or more holes. The pedicels and papillæ have numerous elongate rods, either perforated only at each end and in the middle, or having a series of holes along each side; moreover, the pedicels have bilaterally symmetrical perforated plates round the large terminal plate. The papillæ have a very rudimentary terminal plate. Another specimen, belonging to the Godeffroy Museum, agrees in all respects with the above description, except in the circumstance that the spire of the tables never attains such a great length in the pedicels and papillæ; however, I often found these spires with two transverse beams.

Holothuria fusco-cinerea, Jæger, 1833; Semper, 1868.

Habitat.—Philippine Islands (Semper), Navigator Islands (Semper), Celebes (Jæger), Japan (Ludwig).

A comparison of the description given by Semper with that of the preceding species will show that the two forms scarcely seem to be distinguishable from each other. Even Semper points out that the tables and buttons are much more developed in the ambulacral appendages. I examined one specimen, 220 mm. long, dredged at the Navigator Islands, and preserved in the Zoological State Museum at Stockholm, which agrees in all respects with the specimen brought home from the Fiji Islands, and referred to *Holothuria curiosa*. With regard to the colour, it differs slightly in the absence of the dark rings round the base of the

ambulacral appendages, and by having some darker transverse bands on the back. Even here the deposits of the pedicels and papillæ are considerably more developed than in the body-wall itself, though the tables never seem to attain the unusual length of the spire, nor to have the great number of transverse beams.

Holothuria arenicola, Semper, 1868. *Holothuria maculata* (*Sporadipus*, subgenus *Acolpos*), Brandt, 1835 ; Ludwig, 1881.

Pedicels all over the body. The tables have the smooth disk pierced by a larger central hole and several small peripheral ones; their spire is built up of four rods and one transverse beam, and terminates in several teeth. The oval buttons regularly with six holes.

Habitat.—Philippine Islands, Amboina, Fiji Islands, and Surinam (Semper), Boninsima (Brandt), Mauritius (Haacke, Ludwig).

(Mus. Holm.) One specimen brought home from the Navigator Islands. Length, 100 mm. Colour—light yellowish-grey, with a row of distant darkish-brown spots along each dorsal ambulacrum; also some minute scattered spots. Anus surrounded by five groups of small papillæ. Tentacles very minute. Calcareous ring of the usual shape. Two Polian vesicles and a bundle of three small madreporic canals on the right side of the dorsal mesentery. The tables greatly resemble those in *Holothuria impatiens*, but they have not the nine nearly equal holes in the disk, which on the contrary is perforated by a large central hole and a varying number of small peripheral holes. The spire terminates in twenty or more teeth. The buttons are very symmetrical, as a rule with six holes. Considering that the ambulacral appendages, which have a well-developed terminal plate, are quite retracted within the body-wall, it is uncertain whether they really are pedicels. The supporting rods of these pedicels are smooth, slightly enlarged, and perforated at the middle and the ends. The species is probably very nearly related to the preceding one, and distinguishable from it only by the shape of the buttons.

β. Disks of the tables spinous on the margin and more or less developed. Number of tentacles typical, twenty.

Holothuria signata, Ludwig, 1875.

Dorsal surface with scattered papillæ; ventral surface with pedicels arranged in three longitudinal series. Tables with rudimentary spinous disk and the top of the narrow spire rounded, devoid of spines. The oval buttons with two to four holes, two considerably larger; several developmental stages of the buttons not rare.

Habitat.—Tahiti (Ludwig).

The tables bear the closest resemblance to those of *Holothuria surinamensis, Holothuria flavo-maculata,* and *Holothuria fusco-coerulea.* Hence, I am almost convinced that even here the spinous end of the tables is turned upwards in the living animal; and if so, the species cannot, of course, be placed in this group.

Holothuria poli, Delle Chiaje, 1823, 1841; Selenka, 1867; von Marenzeller, 1874. *Holothuria tubulosa,* Blainville, 1834. *Holothuria tubulosa,* var. *poli,* Lamarck, 1840. *Sporadipus stellati,* Grube, 1840. *Holothuria stellati,* Sars, 1857. *Holothuria glabra,* Semper, 1868.

Habitat.—Mediterranean Sea (Grube, Sars, Selenka, von Marenzeller, Ludwig, Græffe), Canary Islands (Ludwig), west coast of France (Barrois).

In spite of the very valuable contributions to the knowledge of the Mediterranean Holothurians, by Sars, Ludwig, and, above all, by von Marenzeller, several forms seem to be incompletely described, and among these is the species in question. I have not succeeded in accurately understanding the shape of the tables, the size of the dorsal ambulacral appendages, &c. In the Zoological State Museum at Stockholm are several forms, dredged at Naples, Salerno or Amalfi, Cagliari, and finally "two types" from Lesina and Pola, kindly placed at my disposal by von Marenzeller. The largest specimen was obtained at Naples, and has a length of 175 mm. Its colour is blackish-brown inclining to violet, with the ends of the dorsal and ventral ambulacral appendages whitish. The ventral appendages, considerably more crowded than the dorsal, are true cylindrical pedicels with a large sucking-disk and a well developed terminal plate surrounded by irregularly perforated rods and bilateral, elongate perforated plates. The dorsal appendages appear to be of two kinds; true pedicels resembling the ventral but smaller; and more scattered conical papillæ seemingly situated on the top of low elevations. These papillæ have a very rudimentary terminal plate and numerous curved rods. The tables are comparatively rare and undeveloped, consisting of a small spinous or angular disk, and a small generally incomplete spire. The buttons are much crowded, thick and nearly smooth or with slightly uneven surfaces, but are never provided with spines or knobs; they vary greatly, some being small, nearly circular, with but four holes, others being more or less elongate, with as many as eight or ten holes. Sometimes the buttons are even entirely devoid of holes. A single Polian vesicle and madreporic canal are present. The numerous small specimens dredged at Cagliari differ from the above description by their brown colour as well as by the buttons being more irregularly formed, and not unfrequently furnished with some low knobs, so that they may possibly be referable to another species.

Holothuria sanctori, Delle Chiaje, 1823 and 1841; Grube, 1840. *Holothuria tubulosa*, var. *sanctori*, Lamarck, 1840.

Habitat.—Mediterranean Sea (Delle Chiaje, Grube, Ludwig).

Von Marenzeller kindly placed in my hands an example of this species dredged at Naples. Length in contracted state, 45 mm. Colour dark brown, slightly lighter on the ventral surface, and with four more or less irregular rows of light brown or yellowish spots along the dorsal surface. The five ambulacra are indicated by low ridges. The ventral pedicels are not very closely placed, have distinct sucking-disks, and well-developed terminal plates surrounded by bilaterally symmetrical, elongate, perforated plates, or even by irregularly perforated rods. So far as I can see, the dorsal appendages are of two kinds—pedicels smaller than the ventral, with well-marked sucking-disks and terminal plates surrounded by slightly curved rods mostly with none or a few holes; and small conical papillæ, running out apparently from low warts in four rows corresponding to the four yellowish spaces. These papillæ have a very rudimentary terminal plate and numerous strongly curved, smooth or slightly spinous rods having the ends slightly enlarged and perforated. The buttons are of an oval or elongated form, smooth and provided with six to twelve or sometimes fewer holes; it is not very rare to find buttons which are more or less deformed, sometimes presenting themselves as perforated, elongate, hollow or compact ellipses. The tables are well developed, having the large rounded disk mostly spinous on the margin, and perforated by a large central hole and a circle of peripheral ones. The spires are composed of four rods and one transverse beam, and their annular top bears as many as twelve teeth.

Holothuria pardalis, Selenka, 1867.

Pedicels all over the body. Tables with a spinous disk and having the spire terminating in eight to ten teeth. Buttons more or less regularly formed, of the usual shape, but accumulated in circles or rings.

Habitat.—Sandwich Islands and Zanzibar (Selenka), Navigator Islands and Port Mackay (Semper), Mozambique (Semper), Red Sea (Semper, Ludwig), Nangkauri (Ludwig), Glorioso Islands (Bell).

(Mus. Holm.) One specimen from Nangkauri, presented by Professor Möbius. Length 110 mm. Colour in alcohol, light dirty brown. The tables have often their spinous disks small and annular and the spire slightly reduced. The buttons, collected in groups or circles, are often very asymmetrical, generally pierced with six or more holes; sometimes only one side of them is developed, and they not unfrequently bear some indistinct elevations. The dorsal appendages are supported by slightly curved almost smooth rods, with the ends slightly enlarged and perforated, and their terminal plates are small. The ventral pedicels have a large terminal plate and bilaterally symmetrical, perforated rod-like plates.

Another specimen, which is preserved in the State Museum at Stockholm, evidently belongs to this species. It is of a light greyish-brown colour, with a row of about ten dark spots along each dorsal ambulacrum. The dorsal ambulacral appendages have a slightly conical form. The spire of the tables is more or less reduced. The buttons are robust and collected in larger and smaller circles. A third specimen from Ecoa, belonging to the Godeffroy Museum, bears a great resemblance to the former, though the dorsal spots are not very distinct, and the circles of irregular buttons give to the surface of the skin a granulated aspect. Even here the small scattered dorsal appendages resemble papillæ.

Holothuria subditiva, Selenka, 1867.

Habitat.—Panama (Florida ?) (Selenka), Surinam (Semper).

Closely allied to the preceding species, and distinguishable from it mainly by the buttons not being collected into groups or circles. It possesses the two rows of dark spots along the back.

Holothuria lineata, Ludwig, 1875. *Labidodemas punctulatum*, Haacke, 1880 (according to Ludwig, 1883).

Habitat.—Bowen and Red Sea (Ludwig), Mauritius (Ludwig, Haacke), Thursday Island (Bell).

According to Ludwig, this species is nearly related to *Holothuria pardalis*, and, for my own part, I find it almost impossible to distinguish them from each other. In the Zoological State Museum at Stockholm I examined two specimens, one from Wallis Island and one from Rockhampton, the former differing from the typical *Holothuria pardalis* only in the circumstance that the rather asymmetrical buttons are scattered, the latter agreeing more with it in having the buttons collected into masses but not into distinct rings or circlets. Colour—dirty yellowish-grey, speckled with brownish, paler along the ambulacra, the three ventral of which are marked out by a fine darker line. Anus with a crown of small papillæ. Buttons asymmetrical and mostly incomplete. The tables have not so large a disk, as indicated by the figures of Ludwig, and the spines on the margin seem to be fewer, often eight, and larger; the spire is seldom complete, and is then very short with about eight teeth. Tentacles and calcareous ring uncommonly small. What is the difference between this species and *Holothuria subditiva ?*

Holothuria peregrina, Ludwig, 1875.

Habitat.—Bowen and Upola at Navigator Islands (Ludwig), Thursday Island (Bell).

Like the two preceding species. A re-examination is necessary.

Holothuria insignis, Ludwig, 1875.

Habitat.—Bowen, Hong Kong, and Red Sea (Ludwig).

Even this form resembles the three preceding very strikingly, and probably they are all varieties of the same species, and nearly related to *Holothuria pardalis*.

Holothuria inhabilis, Selenka, 1867.

Pedicels all over the body. The solid tables have twelve spines on the margin of the disk. The very numerous buttons are of a more unusual shape, symmetrical, swollen, with two rows of "minute" holes, about four holes in each row; the surfaces of the buttons are uneven owing to the presence of flattened elevations (no knobs), and their margin is deeply undulated.

Habitat.—Sandwich Islands and Society Islands (Selenka).

Holothuria rugosa, Ludwig, 1875.

Ventral surface with numerous pedicels; dorsal surface with scattered papillæ. The tables consist of a large spinous disk and a long conical spire which is usually composed of six rods, and carries four to six long and strong teeth on the top. The buttons have six to seven pairs of holes.

Habitat.—Navigator Islands and Waygeeoo (Ludwig).

(Mus. Holm.) One specimen, 160 mm. long, from Pelew Islands, and two from New Britain. Colour, yellowish-white. The tables have the characteristic form mentioned by Ludwig, but the conical spire seems mostly to be composed of only four rods, though I found tables with even six rods and with more teeth. The buttons are fewer in number than the closely placed tables, and among those with numerous holes I even found buttons with only six holes. Papillæ and pedicels supported by transformed tables and numerous bilaterally symmetrical, perforated plates; the former with very rudimentary terminal plates, the latter with well-developed ones.

γ. Disks of the tables spinous or smooth on the margin. Number of tentacles from twenty-five to thirty.

Holothuria discrepans, Semper, 1868.

Ventral surface with numerous pedicels; dorsal surface with thinly scattered papillæ. The rounded disk of the tables with undulated smooth margin, seldom provided with a few spines, and having commonly some of the peripheral holes confluent with the central one. Spire terminating in several teeth (about twelve). Buttons of more symmetrical and usual shape, with about six holes, present only near the pedicels. Tentacles thirty.

Habitat.—Navigator Islands (Semper).

(Mus. Holm.) One specimen from the Navigator Islands. The ambulacral appendages being retracted, it is very difficult to distinguish the difference between the pedicels and papillæ; possibly the latter have a smaller terminal plate and more numerous rod-like supporting rods. The buttons are sometimes furnished with eight holes instead of six.

Holothuria immobilis, Semper, 1868. *Holothuria collaris*, Haacke, 1880 (according to Ludwig).

Ventral surface with pedicels; dorsal surface with papillæ. The disks of the tables spinous. The buttons irregularly formed, with about six holes. Tentacles twenty-eight to thirty.

Habitat.—Philippine Islands (Semper), Mauritius (Haacke, Ludwig).

According to Semper, the deposits resemble those of *Holothuria pardalis*, consequently the spire of the tables terminates in eight to ten teeth.

(Mus. Holm.) One specimen dredged at the Navigator Islands. Length, 155 mm. Colour—ventral surface dirty yellowish-white, especially anteriorly, inclining to brown; dorsal surface brown with darker spots or bands; papillæ and tentacles almost white. Tentacles twenty-six. Anus with some papillæ. The spire of the tables is short but well-developed, and its annular top carries eight to ten or more teeth. The disks bear distinct spines round the margin, and are perforated with a larger central almost quadrangular hole and several smaller peripheral ones. The buttons are more or less asymmetrical, typically with six holes, but often with fewer. The papillæ are provided with a rudimentary terminal plate and with curved rods which are generally enlarged and perforated at the ends. The pedicels have a well-developed terminal plate, a few rods and perforated bilateral plates. Two very long Polian vesicles. A bundle of about ten small madreporic canals present on the right side of the dorsal mesentery, and only two such canals placed on the left side.

Holothuria cæsarea, Ludwig, 1875.

Pedicels all over the body excepting towards the extremities, where papillæ are substituted for pedicels. Deposits like those in the preceding species. Tentacles thirty.

Habitat.—Navigator Islands (Ludwig).

Further investigations will doubtless prove that there exists no specific distinction between the three forms above mentioned, but that they represent the same species, which, however, may be capable of variation in several respects.

Holothuria samoana, Ludwig, 1875.

Dorsal surface with papillæ; ventral surface with pedicels. The disks of the tables are rounded and smooth. The long conical spire is built up of four slightly spinous rods, and three to four transverse beams; it terminates in four teeth. The rather large buttons are not very symmetrical, and are pierced with about fourteen holes. Tentacles twenty-five.

Habitat.—Navigator Islands (Ludwig).

2. *Buttons never smooth, but rough or uneven, owing to scattered or more densely crowded, minute, or rather large elevations, knobs or spines. In complete state they have two rows of holes.*

Holothuria sulcata, Ludwig, 1875.

Pedicels all over the body. Disks of the tables small, nearly annular, spinous on the margin; the short spire terminates in about twelve teeth. The buttons are mostly incomplete, of unequal size, and irregularly knobbed. On the ventral perisome the openings on the buttons are not unfrequently closed so that they resemble oval knobbed disks.

Habitat.—West Indies (Ludwig).

Holothuria occidentalis, Ludwig, 1875.

Pedicels all over the body. The small but solid tables have the disks reduced and spinous, and the short spire terminating in four groups of three teeth each. The oval or oblong buttons have four to ten holes and numerous small knobs; they are often incomplete.

Habitat.—West Indies (Ludwig).

Several characters mentioned by Ludwig in his diagnosis seem to confirm the near relation of this form to the preceding. Ludwig has had at his disposal only one specimen of each, so that a re-examination may be useful.

Holothuria notabilis, Ludwig, 1875.

Pedicels all over the body. The tables in the ventral perisome have an irregular disk with spines on the margin, and a spire reduced to four spines; on the dorsal surface the disks are larger and the spire more highly developed. The small oval buttons have six holes and several knobs.

Habitat.—Bowen (Ludwig).

Holothuria helleri, von Marenzeller, 1877. *Holothuria affinis*, Heller, 1868.

Dorsal surface with papillæ situated on low warts; ventral surface with pedicels mostly placed along the ambulacra. The disks of the tables are round,

constantly with eight peripheral holes, and supporting a long slender spire of four rods, and usually three transverse beams; top of the spire carrying teeth. The knobbed buttons, which have three to four holes, do not always seem to be present.

Habitat.—Mediterranean Sea (von Marenzeller, Heller, Græffe, Ludwig).

(Mus. Holm.) Three specimens from Lesina, kindly presented by von Marenzeller. The dorsal appendages present a great resemblance to true pedicels. The ventral pedicels form three irregular longitudinal series. In the specimens at my disposal I found, among the more typically formed tables, others which have a much larger and irregularly shaped disk, pierced with more holes and provided with a longer spire. Two of the individuals have scattered, complete or incomplete buttons, while the third is more richly provided with buttons, pierced with six or more holes, and bearing several irregularly placed knobs.

Holothuria tubulosa, Gmelin, 1788; Tiedemann, 1816; Sars, 1857; Selenka, 1867; Marenzeller, 1874. *Mentula marina*, Plancus, 1760. Die *Zitterblase*, Bohadsch, 1776. *Fistularia tubulosa*, Lamarck, 1816. *Holothuria columnæ*, Delle Chiaje, 1823. *Holothuria maxima*, Delle Chiaje, 1823. *Holothuria pentagnæ*, Delle Chiaje, 1823.

Dorsal surface with large papillæ; ventral surface with pedicels. The small and scattered tables have the disks spinous on the margin, and the short spire terminating in about twelve teeth. The ventral perisome contains numerous thick swollen elliptic buttons, densely covered with spines, and mostly devoid of holes, but not unfrequently with from two to fourteen very minute ones; there are also to be found buttons which are more sparingly provided with spines, or rather knobs, and smaller rounded bodies with uneven surfaces and two openings. In the dorsal perisome the buttons are densely knobbed and provided with larger holes.

Habitat.—Mediterranean Sea (Grube, Heller, Græffe, Sars, von Marenzeller, Selenka, Ludwig, &c.), south-west coast of France (Fischer), Portinho (Greeff), Canary Islands (Greeff).

(Mus. Holm.) Several specimens from Naples, Salerno, Bay of Muggio, and Lesina. The species is easily known by its deposits. A part of the dorsal papillæ run out from rather prominent wart-like elevations; this, however, is not equally distinct in all specimens. The supporting plates of the pedicels are never smooth, as is the case in the following species.

Holothuria stellati, Delle Chiaje, 1823; Semper, 1868; von Marenzeller, 1874. *Sporadipus glaber*, Grube, 1840. *Holothuria tubulosa*, var. *stellati*, Lamarck, 1840. *Sporadipus stellati*, Delle Chiaje, 1841. *Holothuria glabra*, Grube, 1864.

Dorsal surface with small papillæ; ventral surface with pedicels. Deposits like those of the preceding species, excepting that the spinous elliptical buttons are absent.

Habitat.—Mediterranean Sea (Grube, Heller, von Marenzeller, Graeffe, Ludwig, &c.).

(Mus. Holm.) Three specimens from Lesina, presented by von Marenzeller. All the ambulacral appendages being withdrawn into the body-wall, it is almost impossible to determine their true appearance. They seem to be of nearly equal size, and to be equally distributed all over the body. A closer microscopical examination reveals the fact that the ventral are more like pedicels in having a larger terminal plate, bilateral perforated rod-like nearly smooth plates, and strong rods with obtuse spines round the margin; some small holes occur in the slightly enlarged ends of the rods. In the dorsal papillæ the rods are smoother and the terminal plates rudimentary. As in *Holothuria poli*, the tables are more rare and their disk is reduced to a spinous ring; the spire terminates in about twelve teeth. The buttons have the same aspect as those in the species just mentioned—namely, rounded or oval, with none, two, four, six, or even more holes—but they are always densely covered with minute conical elevations, consequently their surfaces are very rough. The dorsal buttons are commonly larger, with more distinct holes.

Holothuria mammata, Grube, 1840; Ludwig, 1879. *Holothuria tubulosa*, Semper, 1868 (*partim*).

The dorsal papillæ often placed on hemispherical warts, forming five or six irregular rows. The ventral pedicels not very crowded, fewest at the middle of the ventral surface.

Habitat.—Mediterranean Sea (Grube, Ludwig).

(Mus. Holm.) Four specimens from Salerno or Amalfi, agreeing in all respects with the description of Ludwig. In the spaces between the large characteristic hemispherical warts, small ambulacral appendages may be found. The deposits seem to be in an advanced state of solution, but bear a certain resemblance to those of *Holothuria tubulosa* or *Holothuria stellati*, with which species this form must be closely allied. The tables are rather incomplete, with a simple annular disk and a spire made up of four rods and one transverse beam. The dorsal papillæ have a rudimentary terminal plate and numerous curved rods with some spines or perforations. The ventral pedicels have a well-developed terminal plate surrounded by bilateral perforated elongate plates and irregularly perforated rods.

Holothuria pleuripus (*Cystipus*), Haacke, 1880; Ludwig, 1883.

Habitat.—Mauritius (Haacke, Ludwig).

According to Ludwig, this species resembles the following one in habit as well as in the shape of the ventral deposits; in the dorsal perisome, on the contrary, the long buttons are altogether covered with knobs, and the tables are very remarkable in having the disks almost completely reduced and the spire transformed, the tables themselves acquiring a spherical aspect. In the Zoological

State Museum at Stockholm one of the original specimens which was brought home from Mauritius is preserved. Length, 50 mm. Colour—light greyish, here and there inclining to brownish. Body depressed, with a kind of brim at the area of transition between the dorsal and ventral surfaces. An alternating double row of small warts or papillæ is to be found on the brim along each side of the body; the dorsal surface bears similar scattered warts and numerous very minute papillæ. The arrangement of the minute ventral pedicels in three longitudinal series is not very distinct. Tentacles minute. The ventral buttons are provided with three to seven pairs of holes, and usually with numerous distinct knobs on the margin as well as on the middle beam; but, as a rule, the longer buttons have not their knobs so well marked. The ventral tables consist of a rounded, slightly convex disk, pierced with a larger central hole and several small peripheral ones, but their spire is low, often very irregular, sometimes built up of four rods and one transverse beam, and provided with several or numerous small teeth on the top; sometimes the spire seems to be composed of more than four rods, thus almost resembling hemispheres, a result of the presence of secondary rods uniting the margin of the disk with the top of the spire, whereby the peripheral holes in the disk become placed inside these secondary oblique rods. Thus, the ventral deposits here described do not fully agree with those in *Holothuria bowensis*, as pointed out by Ludwig. All the buttons seem to be more or less uneven from the presence of knobs. The dorsal buttons bear very distinctly-marked knobs, and the tables of the same surface are considerably larger, resembling perforated spheres or hemispheres. In the dorsal papillæ the tables are often of a more regular and delicate construction, consisting of a small annular disk and a slender conical spire, built up of four rods and two to three transverse beams, the top itself terminating in a few small teeth. The pedicels and papillæ are supported by numerous crowded rods, slightly perforated at the middle and at each end; moreover, the pedicels contain oval bilaterally perforated plates and a larger terminal plate. In the Godeffroy Museum I have seen three specimens, two from the Fiji Islands and one from Tahiti, agreeing in all respects with the above description, excepting that the ventral pedicels are evidently arranged in three longitudinal series.

Holothuria rigida (*Stichopus*), Selenka, 1867; Semper, 1868.

Dorsal surface with papillæ; ventral surface with three rows of pedicels. The tables have a spire made up of "eight" rods and terminating in numerous teeth. Buttons of two kinds—oval knobbed ones with six, seldom eight, holes and a deeply undulated margin; and large rounded spinous elliptical ones mostly pierced with six to ten holes, but often quite devoid of holes.

Habitat.—Zanzibar, Society Islands, and Florida (Selenka).

From the figure given by Selenka, it seems somewhat uncertain whether the oval buttons are entirely smooth or provided with low rounded elevations.

3. *Buttons—smooth ones in company with knobbed.*

Holothuria bowensis, Ludwig, 1875.

Ventral surface with pedicels; dorsal surface with papillæ. The tables have a well developed, smooth, symmetrical disk, perforated with a central hole surrounded by a simple or double circle of peripheral ones, and a slender spire made up of four rods and four or five transverse beams; the spire is spinous not only at the top, but also in its neighbourhood. The buttons are partly smooth elongate, with three to seven pairs of holes, partly smaller oval with three pairs of holes and some knobs on the middle beam.

Habitat.—Bowen (Ludwig).

4. *Buttons either partly or altogether transformed into fenestrated hollow eggs.*

Holothuria coluber, Semper, 1868.

Dorsal surface with papillæ; ventral surface with pedicels. The tables like those in *Holothuria martensii*, thus having a long spire of four rods and three to five transverse beams. Buttons partly regularly formed, partly transformed into hollow fenestrated eggs.

Habitat.—Philippine Islands (Semper).

According to Semper, the tables are like those in *Holothuria martensii*, but, judging from the figures given by the same author, their disks are not smooth on the margin but uneven, dentate, or spinous. The meaning of "regularly formed buttons" is not clear, as it leaves undecided the smooth or knobbed character of the buttons.

Holothuria chilensis, Semper, 1868.

Pedicels all over the body. The disks of the tables have a slightly uneven margin, and the spire, built up of four rods and one transverse beam, terminates in about twelve teeth. The buttons are often transformed into hollow fenestrated eggs.

Habitat.—Chili (Semper).

Even here the description of Semper is not entirely satisfactory with regard to the buttons, whether they are smooth or not. In the explanation of the plates he speaks of "rosettes," which are not mentioned in the text.

Holothuria kubaryi, Ludwig, 1868.

Pedicels all over the body. Deposits like those in *Holothuria coluber*.

Habitat.—Pelew Islands (Ludwig).

Further investigations are required to prove whether there really exist any differences between this species and *Holothuria coluber*, which at least must be nearly allied. *Holothuria kubaryi* has a whitish colour, the spire of the tables lower and more spinous, and pedicels all over the body, while *Holothuria coluber* is blackish, and has pedicels as well as papillæ, &c.

II. Ambulacral appendages—papillæ alone.

1. *Buttons smooth.*

Holothuria princeps, Selenka, 1867.

The disk of the tables provided with twelve spines on the margin, and the spire, made up of four rods and one transverse beam, terminates in eight teeth. The buttons of delicate construction, symmetrical, and undulated on the margin. In the papillæ the tables are transformed, presenting themselves under the shape of conical slender bodies with the disk reduced to a simple ring and the spire terminating in a simple point.

Habitat.—Florida (Selenka), Egmont Key (Verrill).

The species is characterised by the radial pieces of the calcareous ring being prolonged and bifurcated posteriorly. To judge from the figure given by Selenka, the buttons must be smooth and pierced with six holes, though the author does not mention anything about that in the text.

Holothuria impatiens (*Fistularia*), Forskaal, 1775; Gmelin, 1788; Semper, 1868; Ludwig, 1875. *Trepang impatiens*, Jæger, 1833. *Thyone impatiens*, Blainville, 1834. *Sporadipus impatiens*, Grube, 1840. *Holothuria botellus*, Selenka, 1867 and 1868; Semper, 1868. *Holothuria fulva*, Quoy and Gaimard, 1833.

The smooth solid disks of the tables are, as a rule, pierced with nine nearly equally large holes in three rows, and the spire, made up of four rods and one or two transverse beams, terminates in numerous teeth. The symmetrical buttons have always six holes.

Habitat.—Mediterranean Sea (von Marenzeller, Grube, Ludwig, Semper, &c.), Red Sea (Gray, Forskaal, Ludwig, Semper), Gulf of Suez (Gray, Semper), Zanzibar (Selenka), Mauritius (Haacke, Ludwig), Mozambique (Semper, Bell), Madagascar (Ludwig), Amboina (Ludwig, Semper), Philippine Islands, Navigator Islands, Fiji Islands, Nicobar Islands, Pelew Islands, MacKean's Island and Palma (Semper), Society Islands, Sandwich Islands, Tortugas, Florida, and Panama (Selenka), Java (Semper, Kuhl and Hasselt), Timor, Banda, Cape York, Tahiti, and Surinam (Ludwig), New Holland (Quoy and Gaimard).

(Mus. Holm.) Several specimens from Friendly Islands, Navigator Islands, Mauritius, and St. Bartholomew.

(Mus. Godeffroy). Several specimens from Marquesas, Apia, Eooa, and the Fiji Islands. Papillæ numerous, equally distributed all over the body, and situated on rounded warts. Colour in alcohol, lighter or darker brownish inclining to violet. Integument rough. The tables have more rarely two transverse beams, and terminate in about twenty or more teeth. The buttons are crowded, smooth, symmetrical, oval, always with six holes. The papillæ are supported by a rudimentary terminal plate and numerous transverse rods, which are commonly perforated at the enlarged ends and the dilated middle. In one of the specimens examined the Cuvierian tubes are very large, the madreporic canal single, and the Polian vesicles two in number. In the specimen brought home from St. Bartholomew two transverse beams are usually present on the tables.

Holothuria gracilis, Semper, 1868.

The tables like those in the preceding species, but never with two transverse beams. The buttons mostly with larger and more numerous holes (about twelve), and of a more irregular form.

Habitat.—Philippine Islands and Pelew Islands (Semper).

The species, as Semper says, is doubtless more closely allied to the preceding one than to *Holothuria pardalis*.

Holothuria verrucosa, Selenka, 1867.

Habitat.—Sandwich Islands (Selenka), Indian Ocean (Ludwig).

The species does not seem to be well defined. The tables are very solid, with teeth on the margin of the disk. The buttons are not more minutely described. The tentacles form two concentric circles (?). The papillæ with numerous spinous or perforated plate-like rods.

2. *Buttons knobbed.*

Holothuria scabra, Jæger, 1833; Semper, 1868. *Holothuria tigris*, Selenka, 1867 and 1868.

The tables are solid, with a smooth, well-developed disk, and with the spire of the usual shape, terminating in several teeth (twelve to sixteen). The buttons are symmetrical, with six holes, and for the most part knobbed.

Habitat.—Fiji Islands, Pelew Islands, Querimba, and Philippine Islands (Semper), Mauritius (Haacke, Ludwig), Amboina, Java, Caroline Islands, and Zanzibar (Selenka), Red Sea (Ludwig, Semper), Berbera, Timor, Macassar, and Banka (Ludwig), Celebes (Jæger).

(Mus. Holm.) Several specimens dredged at Mauritius, Torres Strait, Gulf of Siam, Fiji Islands, Singapore, Java, and Port Natal. The colour is somewhat variable in the different individuals. In that from Mauritius, which has a length of 170 mm., the dorsal surface is cinereous, with almost black transverse bands corresponding to transverse furrows, and with a few small whitish bands or spots; the ventral surface is yellowish-white, and the papillæ are surrounded by a small dark circle. The specimen obtained at the Fiji Islands has the back much paler and punctated, provided with a few larger darker spots, but devoid of the blackish transverse bands. The specimens from Java and Singapore also possess such transverse bands, but in the latter the bands are whitish, with black outlines. Anus not very distinctly stellate. Mouth surrounded by a brim-like circle of papillæ. All the ambulacral appendages are papillæ, not pedicels as Selenka says; the ventral are sometimes slightly larger than the dorsal. The internal organisation agrees with that described by Selenka. The solid tables have the spire built up of four rods and one transverse beam, and terminating in sixteen to twenty-five teeth, or even more. The disks of the tables are mostly well-developed, smooth on the margin, and pierced by a larger central hole and a peripheral circle of small ones. The buttons vary slightly in shape, but are mostly oval with six holes; they are seldom or never entirely smooth, but more or less distinctly provided with knobs. I often found only two knobs placed on the middle beam, but not unfrequently knobs, or at least rounded elevations may be met with on the periphery. Here and there more delicately constructed buttons, provided with more prominent and numerous knobs, are to be observed. The papillæ are supported by a very rudimentary terminal plate, by transverse rods enlarged and perforated at the middle and at each end, and by larger and longer almost completely smooth buttons, often with more than six holes.

Holothuria aculeata, Semper, 1868.

Habitat.—Philippine Islands (Semper).

The deposits of this species seem to be scarcely distinguishable from those in the preceding one, with which it must be nearly allied. Possibly the buttons are of a more irregular shape and have the margin more obviously undulated. Semper figures six knobs on these buttons. Besides, this species is in possession of five indistinct groups of papillæ round the anus. A re-examination is necessary.

Holothuria fusco-punctata, Jæger, 1833; Semper, 1868.

The tables like those in the preceding form, excepting that the disks are reduced to a simple ring with some small irregular processes. The buttons are slightly irregular, oblong, with an undulated margin; they have numerous knobs and about twelve holes.

Habitat.—Celebes (Jæger, Semper).

The above description of the deposits is in conformity with the figures given by Semper. The species is distinguished from *Holothuria aculeata* even by the want of supporting rods in the papillæ.

Holothuria albiventer, Semper, 1868.

The tables have the large rounded disk perforated with numerous smaller holes and the margin smooth; the short spire is formed by six to ten rods (instead of four, which is the common number), and its large hemispherical top is covered with small spines or teeth. The oval symmetrical buttons have six holes and two knobs on the middle beam.

Habitat.—Philippine Islands, Amboina, and Red Sea (Semper).

(Mus. Godeffroy.) One specimen from the Pacific Ocean. Tentacles slightly unequal. Mouth ventral, surrounded by a crown of small papillæ. Five indistinct groups of small rough papillæ or papilliform elevations at the anus. Ambulacral appendages—rigid rough papillæ of obviously conical form, those on the ventral surface larger and fewer than the dorsal ones which are more crowded and more unequal in size. Colour—ventral surface dirty grey and finely punctated, with the papillæ whitish; dorsal surface dark almost blackish-brown; tentacles yellowish-brown. A single Polian vesicle and madreporic canal, the latter rather long and like an elongate vesicle. The calcareous ring has the radial pieces much more deeply furrowed anteriorly than is indicated by Semper. The disks of the tables are rather large, smooth on the margin, and perforated by numerous small holes, the central of which are of about the same size as the rest; the under surface of the disks is distinctly convex. The spire, sometimes longer, sometimes shorter, is built up of more than four, not unfrequently about ten, rods, and terminates in a rounded very spinous top; a side view of the spire often presents some minute superposing holes, indicating the presence of two or three transverse beams, which, however, are very indistinct. Among these tables I find some scattered ones with more elongated spires. The typical form of buttons is the oval one, with six holes and two distinct knobs on the middle beam, and with a series of rounded, sometimes very indistinct, sometimes, on the contrary, rather prominent elevations round the margin. Here and there other buttons may be seen of a more elongated shape and furnished with more holes and knobs. The ventral papillæ contain the following deposits—knobbed buttons like those in the body-wall itself; tables of the above mentioned kind as well as others with the spire much longer, narrower, having five to eight transverse beams and often some spines on the sides; smooth curved supporting rods with some holes at the middle and at the ends; and some elongated, bilateral, perforated plates round the rudimentary terminal plate. The dorsal papillæ seem to be devoid of such bilateral perforated plates, and have the terminal plate much more fragmentary or even absent.

Holothuria martensii, Semper, 1868.

The tables have a smooth or slightly uneven disk and a long spire composed of four rods and three to five transverse beams. The buttons commonly provided with six holes and two knobs on the middle beam.

Habitat.—Amboina (Semper), Celebes and Banda (Ludwig).

(Mus. Holm.) One specimen from Banka and another from Darnley Island. Concerning my own researches regarding these specimens, I may refer to what is said with regard to the Challenger specimens (p. 177), with which they agree in most respects. It may, however, be pointed out that the disks of the tables in the latter specimen seem to be considerably larger and more irregular, and that the spire seems to be longer; even the buttons have generally more holes and knobs, and attain a greater length.

3. *Buttons of two kinds, smooth and knobbed.*

Holothuria squamifera, Semper, 1868.

In addition to the smaller more numerous tables of the usual shape, much larger ones may be found, having the disk more richly perforated and the spire long, narrow, and provided with several transverse beams (about five). The smooth buttons have eight to twelve holes; the knobbed ones are less common and of slightly more irregular shape.

Habitat.—Philippine Islands, Navigator Islands, and Java (Semper).

The papillæ of this species are scale-like, and the mouth is surrounded by small groups of papillæ.

Holothuria cubana, Ludwig, 1875.

The tables have a knobbed disk and a short spire terminating in numerous teeth. The smooth buttons are slightly deformed, resembling oblong plates with uneven margins and a few small holes. The knobbed buttons are oval, symmetrical, commonly pierced by ten holes, and carrying numerous knobs.

Habitat.—Cuba (Ludwig).

The following forms are mostly very incompletely known and in need of re-examination :—

Holothuria ecalcarea, Sars, 1859 and 1861.

Habitat.—Finmark (Sars), White Sea (Jarzynsky).

Nearly allied to *Holothuria tremula*, and probably identical with it, the calcareous matters having probably been dissolved by some impurity in the alcohol.

Holothuria cavolini, Delle Chiaje, 1823 and 1841.

Habitat.—Mediterranean Sea (Delle Chiaje).

Sporadipus maculatus, Grube, 1840.

Habitat.—Mediterranean Sea (Grube).

Stichopus cinerascens, Grube, 1840.

Habitat.—Mediterranean Sea (Grube).

Holothuria lilla, Lesson, 1830.

Habitat.—Borabora in Society Islands (Lesson).

Holothuria subrubra, Quoy and Gaimard, 1833.

Habitat.—Mauritius (Q. and G., Hoffmann).

Holothuria maxima (*Fistularia*), Forskaal, 1775; Selenka, 1867.

Habitat.—Red Sea (Forskaal, Rüppel), Mozambique (Bell).

Holothuria obscura, Lesueur, 1824. *Actinopyga obscura*, Verrill, 1867 to 1871.

Habitat.—St. Bartholomew (Lesueur).
Compare the above description of *Holothuria lubrica*.

Holothuria aglutinata, Lesueur, 1824. *Bohadschia agglutinata*, Verrill, 1867 to 1871.

Habitat.—St. Bartholomew (Lesueur).

Holothuria nigra, Peach, 1845; Foot, 1860; Bell, 1884. *Cucumaria niger*, Kinahan, 1859.

Habitat.—British Islands (Peach, Bell, Norman, Kinahan).

Holothuria sordida (subgenus *Microthele*), Brandt, 1835; Ludwig, 1881.

Habitat.—Caroline Islands (Brandt).

Holothuria maculata, Lesueur, 1824.

Habitat.—St. Bartholomew (Lesueur).

Holothuria tigris (subgenus *Microthele*), Brandt, 1835; Ludwig, 1881.

Habitat.—Caroline Islands (Brandt).

Holothuria californica, Stimpson, 1857.

Habitat.—California (Stimpson).

Holothuria ocellata (*Bohadschia*), Jæger, 1833; Semper, 1868.

Habitat.—Celebes (Jæger).

Compare the description of a Challenger specimen referred to this species (p. 178).

Holothuria lineolata (*Bohadschia*), Jæger, 1833; Semper, 1868.

Habitat.—Celebes (Jæger).

Holothuria albiguttata (*Bohadschia*), Jæger, 1833; Semper, 1868.

Habitat.—(?)

Holothuria brunnea, Chamisso and Eysenhardt, 1820.

Habitat.—Guajan among Marianne Islands (Ch. and Eys.).

Holothuria monosticha, Haacke, 1880.

Habitat.—Seychelle Islands (Haacke).

Holothuria fasciata, Lesueur, 1824. *Bohadschia fasciata*, Verrill, 1867 to 1871.

Habitat.—St. Bartholomew (Lesueur).

Sporadipus gigas, Oersted, Verrill, 1867 to 1871.

Habitat.—Caribbean Sea.

Holothuria mollis, Hutton, 1872 and 1879.

Habitat.—New Zealand (Hutton).

Holothuria robsoni, Hutton, 1879.

Habitat.—Cape Campbell, New Zealand (Hutton).

Holothuria maculata, Kuhl and van Hasselt, 1869.

Habitat.—Anjer, Java (Kuhl and van Hasselt).

Holothuria heros, Agassiz, 1852.

Habitat.—Florida (Agassiz).

Holothuria sp., Rathbun, 1879.

Habitat.—Plataforma and Bahia (Rathbun).

Holothuria sp. (*Fistularia*), Forskaal, 1775.

Habitat.—Red Sea (?).

Holothuria sp., Anderson, 1862.

Habitat.—Shetland (Anderson).
Possibly a *Colochirus*.

Holothuria fasciata, Quoy and Gaimard, 1833.

Habitat.—Vanikoro (Q. and G.).

Holothuria lucifugus, Quoy and Gaimard, 1833. *Stichopus lucifugus*, Brandt, 1835.

Habitat.—Carteret (Q. and G.).

Holothuria ophidiana, Quoy and Gaimard, 1833.

Habitat—New Guinea (Q. and G.).

Holothuria umbrina, Rüppell, 1828.

Habitat.—Red Sea (Rüppell).

Ananus holothuroides, Sluiter, 1880.

Habitat.—Java (Sluiter).
Probably a deformed individual of *Holothuria pyxis* or some other species.

Holothuria timama, Lesson, 1830. *Psolus timama*, Jæger, 1833.

Habitat.—Offack in Waigiou (Lesson).

Holothuria forskaalii, Delle Chiaje, 1823, 1841.

Habitat.—Mediterranean Sea (Delle Chiaje).

Holothuria glaberrima, Risso, 1826.

Holothuria ovata, Risso, 1826.

Holothuria mamillata, Risso, 1826.

Holothuria littoralis, Risso, 1826.

Holothuria stellata, Risso, 1826.

Holothuria punctata, Risso, 1826.

These six forms were probably dredged in the Mediterranean Sea. Some of them are probably not Holothurids but belong to other groups of animals.

LIST OF LOCALITIES AT WHICH SPECIMENS TOO FRAGMENTARY FOR ACCURATE DIAGNOSIS WERE OBTAINED.

STATION 274.—September 11, 1875; lat. 7° 25′ S., long. 152° 15′ W.; depth, 2750 fathoms; bottom temperature, 35°·1; Radiolarian ooze. A single pedate Holothurian, in such a defective state that no examination is possible. The specimen probably belongs either to the Psychropotidæ or to those forms of deep-water Aspidochirotæ which present themselves under a shape like that of some of the Psychropotidæ.

STATION 244.—June 28, 1875; lat. 35° 22′ N., long. 169° 53′ E.; depth, 2900 fathoms; bottom temperature, 35°·3; red clay. One very fragmentary specimen. The almost cylindrical ambulacral appendages, probably pedicels, are minute, numerous, and especially crowded along the sides of the body; they do not present any arrangement in rows. The ventral surface seems to be devoid of pedicels. The deposits of the body-wall consist of numerous crowded tables, the delicate disks of which attain a considerable size, about 0·2 mm. in diameter, and are pierced by six large holes surrounding a small central hole; the holes are often not closed, so that the disk seems to consist of six rods radiating from the perforated centre. The spire is composed of three rather long rods and a transverse beam situated near the disk. The spire terminates in three very long teeth. The pedicels are supported by a few more or less curved, spinous rods; their terminal plates are absent, having possibly been dissolved by some impurity in the alcohol. The deposits are very like those in *Holothuria lactea*, but the species differs from the latter by possessing far more numerous pedicels, in having the supporting rods of the pedicels very spinous, &c. There is good reason for believing that the two forms in question may be referred to the same genus, but the material is inadequate to decide this point.

STATION 325.—March 2, 1876; lat. 36° 44′ S., long. 46° 16′ W.; depth, 2650 fathoms; bottom temperature, 32°·7; blue mud. Some very fragmentary specimens, possibly allied to the Elasipoda.

STATION 160.—March 13, 1874; lat. 42° 42′ S., long. 134° 10′ E.; depth, 2600 fathoms; bottom temperature, 33°·9; red clay. A fragmentary Holothurid with respiratory-trees, but possibly without ambulacral appendages. Body of a narrow cylindrical form. Colour white. Two Polian vesicles; and apparently two bundles of slender, slightly branched genital tubes, one on each side of the dorsal mesentery.

STATION 241.—June 23, 1875; lat. 35° 41′ N., long. 157° 42′ E.; depth, 2300 fathoms; bottom temperature, 35°·1; red clay. Two very macerated specimens with the deposits dissolved.

STATION 271.—September 6, 1875; lat. 0° 33′ S., long. 151° 34′ W.; depth, 2425 fathoms; bottom temperature, 35°; Globigerina ooze. Fragments of one specimen (Pl. X. fig. 10).

STATION 244.—June 28, 1875; lat. 35° 22′ N., long. 169° 53′ E.; depth, 2900 fathoms; bottom temperature, 35°·3; red clay. Six specimens. The dorsal surface of the elongate, flattened body carries rather large conical warts. On the ventral surface, which is almost totally destroyed, I have observed some small cylindrical pedicels; but the arrangement of these pedicels is unknown. The integument, which is of a whitish yellow colour, is strengthened by crowded deposits (compare Pl. X. fig. 10) consisting of four slightly curved arms and a long spinous outwardly directed process, the length of which is about 0·09 mm.; the arms, which are slightly shorter, have the ends dilated and perforated. On the ventral surface these deposits seem to be slightly smaller, and sometimes I have seen the ends of some of the arms connected with one another. The deposits bear some resemblance to those found in several Elasipoda, but, to judge from the external appearance, the specimen seems to be more nearly related to the Aspidochirotæ. The tentacles and all the internal organs and a good deal of the body-wall are spoiled.

The six specimens obtained at Station 244 are much smaller, only about 90 mm. long, and they are much better preserved than the former specimen. The body is flat and surrounded by a brim, on the margin of which papillæ or processes are situated. Even the dorsal surface carries such scattered conical papillæ. These papillæ are broad at the base, as much as 5 or 6 mm. in diameter, and their tops are prolonged into a long, narrow, and slender end. So far as I can discover, the ventral surface is furnished with a simple irregular row of small pedicels along each side; these pedicels appear to belong to the lateral ventral ambulacra, while the odd ambulacrum is devoid of them. The mouth is completely ventral in position, and surrounded by nineteen tentacles resembling those in the Aspidochirotæ. The anus is dorsal. The calcareous deposits are like those above described, excepting that they are smaller and that they often have five arms instead of four. From the defective state of the specimens it is impossible to decide whether they belong to the Aspidochirotæ or are Elasipods.

STATION 122.—September 10, 1873; lat. 9° 5′ S. to 9° 10′ S., long. 34° 50′ W. to 34° 53′ W.; depth, 32 to 400 fathoms; red mud. Two specimens in such a deformed state that no closer examination is possible. The animals, being in possession of pedicels and respiratory-trees, but lacking retractors, seem to belong to the Aspidochirotæ. So far as I can see, two bundles of short, simple genital tubes are present. A single Polian vesicle and a very narrow calcareous ring are to be found. The deposits of the body-wall are probably dissolved, but the skin is covered and pierced by an immense quantity of foreign materials.

STATION 211.—January 28, 1875; lat. 8° 0′ N., long. 121° 42′ E.; depth, 2225 fathoms; bottom temperature, 50°·5; blue mud. A fragmentary specimen of an Elasipod. The deposits consist of four-armed spicules with the ends of the arms slightly enlarged, very spinous, and sometimes pierced by a hole. Each arm sends out one

considerable spinous process, and also sometimes some smaller processes; the central part of the deposits is rather long and rod-like, two arms diverging from each extremity.

STATION 45.—May 3, 1873; lat. 38° 34′ N., long. 72° 10′ W.; depth, 1240 fathoms; bottom temperature, 37°·2; blue mud. Fragments of a pedate Holothurid.

STATION 205.—November 13, 1874; lat. 16° 42′ N., long. 119° 22′ E.; depth, 1050 fathoms; bottom temperature, 37°; blue mud. Some fragments of Elasipods (?).

STATION 302.—December 28, 1875; lat. 42° 43′ S., long. 82° 11′ W.; depth, 1450 fathoms; bottom temperature, 35°·6; Globigerina ooze. Fragments of one specimen.

STATION 92.—July 26, 1873; lat. 17° 54′ N., long. 24° 41′ W.; depth, 1975 fathoms; Globigerina ooze. A very incomplete specimen.

STATION 323.—February 28, 1876; lat. 35° 39′ S., long. 50° 47′ W.; depth, 1900 fathoms; bottom temperature, 33°·1; blue mud. Some fragments of Elasipoda doubtlessly belonging to the family Elpidiidæ.

STATION 298.—November 17, 1875; lat. 34° 7′ S., long. 73° 56′ W.; depth, 2225 fathoms; bottom temperature, 35°·6; blue mud. Five very deformed and macerated specimens.

STATION 152.—February 11, 1874; lat. 60° 52′ S., long. 80° 20′ E.; depth, 1260 fathoms; Diatom ooze. Three specimens almost completely destroyed, which seem to be allied to those from Station 298. It is impossible to obtain an idea of the external shape of the body, the exterior layers of the perisome, together with the processes and other ambulacral appendages having been thrown off. However, the body is probably elongate, possibly narrow, and more or less distinctly cylindrical. The number of tentacles is about twenty, but I am by no means sure of it. Two Polian vesicles seem to be present, and a bundle of short, slightly branched genital tubes is situated on each side of the dorsal mesentery. The respiratory-trees are well developed. The colour seems to be dark violet. The specimens obtained at Station 152 are larger; the anterior portion of one specimen measuring about 125 mm. in length and 18 mm. in breadth.

STATION 160.—March 13, 1874; lat. 42° 42′ S., long. 134° 10′ E.; depth, 2600 fathoms; bottom temperature, 33°·9; red clay. One specimen, provided with respiratory-trees. Body elongate, fusiform, about 135 mm. long. The ambulacral appendages are present in the living animal, but they are destroyed in the Challenger individual, so that their arrangement is not distinguishable; however, one can determine that the three ventral ambulacra have been provided with ambulacral appendages, those in the odd ambulacrum being evidently pedicels and disposed in a double row. Tentacles unknown, fifteen or twenty (?). Two Polian vesicles present. A thin bundle of long genital tubes is situated on each side of the dorsal mesentery.

STATION 146.—December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; depth, 1375 fathoms; bottom temperature, 35°·6; Globigerina ooze. One fragmentary specimen belonging either to the Elasipoda or to the deep-water Aspidochirotæ. Colour pale violet. Length, 70 mm.

STATION 89.—July 23, 1873; lat. 22° 18′ N., long. 22° 2′ W.; depth, 2400 fathoms; bottom temperature, 36°·6; Globigerina ooze. A single very deformed specimen. Length about 65 mm. Colour dark violet. Body probably with pedicels or rather papillæ in a row round its sides. Deposits of a peculiar shape; partly larger and smaller cruciform bodies (Pl. X. fig. 12), composed of four more or less strongly curved spinous arms and an outwardly directed central spinous process, partly more scattered, very strongly constructed, cruciform bodies with the curved arms slightly spinous and branched, and with a very long, straight, outwardly directed, central column, terminating in four hooks, like an anchor with four flukes.

STATION 298.—November 17, 1875; lat. 34° 7′ N., long. 73° 56′ E.; depth, 2225 fathoms; bottom temperature, 35°·6; blue mud. One specimen.

STATION 299.—December 14, 1875; lat. 33° 31′ S., long. 74° 43′ W.; depth, 2160 fathoms; bottom temperature, 35°·2; blue mud. One specimen.

The two forms, obtained from the above mentioned Stations, closely resemble *Pseudostichopus villosus*, but, in spite of the most careful examination, I cannot find any pedicels or processes, excepting some small elevations at the anus. Notwithstanding this, the radial ambulacral vessels seem to be present, and I have also observed some small lacunæ within the perisoma, which doubtless are in communication with those radial vessels. Even the elevations in the neighbourhood of the anus contain lacunæ. Here and there some very minute darker points are visible, and these possibly may form a kind of ambulacral appendage. It seems hardly credible that these two forms, which bear such an obvious resemblance to *Pseudostichopus*, especially *Pseudostichopus villosus*, can be totally in want of pedicels. That which makes the investigations of the ambulacral appendages difficult and their results very dubious, is the absence of calcareous deposits in the perisoma.

The two specimens in question are very large, from 220 to 280 mm. long, and of an oval form. Their colour is pale dirty grey, inclining to brownish. The mouth is almost terminal, though turned toward the ventral surface. The anus is almost terminal and enclosed between two vertical folds of the body-wall. The twenty tentacles seem to be discoidal and carry some small retractile processes. The body-wall is very thin, excepting along the sides of the body, where it is slightly thicker. The longitudinal muscular bands are broad and simple. The retractors are absent. The calcareous ring (Pl. X. fig. 14) is devoid of any posterior prolongations, and is notched anteriorly for the longitudinal muscles, &c. A single ventral Polian vesicle and dorsal madreporic canal are present. A bundle of short, thick, slightly branched genital tubes is situated on each side of the dorsal mesentery; the branches of these tubes terminate in oval sacciform dilatations, which in the individual examined by me contained eggs. The respiratory-trees are comparatively well-developed. It is impossible to decide whether deposits have been present in the perisoma or not, though I believe the former to be the case.

GEOGRAPHICAL TABLES.

TABLE I.—Arctic and Antarctic Oceans.

	Arctic Ocean.					Antarctic Ocean.	
	North-eastern part of North America, southwards to Maine.	Greenland, Iceland, and Jan Mayen.	Northern part of Scandinavia, north of the Arctic Circle.	Rest of N. European Continent, incl. Spitzbergen, Bear Isl., Nova Zemlia, and the N. Asiatic Coast to Behring Strait.	Behring Strait, southwards to Kurile Islands and Vancouver's Island.	Kerguelen Islands, Heard Island, Marion Island.	Strait of Magellan, Falkland Islands, and their vicinity.
Synapta inhærens, O. F. Müller,			×	×			
Chirodota studerii, Théel,						×	×
lævis, Fabricius,	×	×	×	×			
purpurea, Lesson,							×
contorta, Ludwig,						×	×
discolor, Eschscholtz,					×		
Myriotrochus rinkii, Steenstrup,	×	×	×	×			
Acanthotrochus mirabilis, Danielsen and Koren,				×			
Trochoderma elegans, Théel,				×			
Ankyroderma jeffreysii, Danielsen and Koren,			×	×			
affine, Danielsen and Koren,				×			
danielseni, n. sp.,							×
Eupyrgus scaber, Lütken,		×	×	×			
Trochostoma boreale, Sars,			×	×			
thomsonii, Danielsen and Koren,			×	×			
violaceum, Studer,						×	
turgidum, Verrill,	×						
arcticum, von Marenzeller,			×	×			
Cucumaria vicaria, Bell,							×
miniata, Brandt,					×		
populifer, Stimpson,					× ?		
calcigera, Stimpson,	×	×		×			
nigricans, Brandt,					×		
glacialis, Ljungman,				×			
lævigata, Verrill,						×	
crocea, Lesson,							×
frondosa, Gunnerus,	×	×	×	×			
vegæ, n. sp.,					×		
minuta, Fabricius,	×	×		×			
mendax, n. sp.,							×
elongata, Düben and Koren,				× ?			
kowalevskii, Jarzynsky,				×			
perspicua, Ludwig,		×					
salmini, Ludwig,					●		×
abyssorum, n. sp.,						×	
var. *hyalina*, n.,						×	

TABLE I.—*continued.*

	Arctic Ocean.					Antarctic Ocean.	
	North-eastern part of North America, southwards to Maine.	Greenland, Iceland, and Jan Mayen.	Northern part of Scandinavia, north of the Arctic Circle.	Rest of N. European Continent, incl. Spitzbergen, Bear Isl., Nova Zemula, and the N. Asiatic Coast to Behring Strait.	Behring Strait, southwards to Kurile Islands and Vancouver's Island.	Kerguelen Islands, Heard Island, Marion Island.	Strait of Magellan, Falkland Islands, and their vicinity.
Cucumaria kerguelensis, n. sp.,						×	
serrata, n. sp.,						×	
var. *intermedia*, n.,						×	
var *marionensis*, n.,						×	
Echinocucumis typica, Sars,			×	×			
Thyone spectabilis, Ludwig,							×
fusus, O. F. Müller,			× *s*				
meridionalis, Bell,							×
muricata, Studer,						×	
cigaro, Troschel,	×						
recurvata, n. sp.,						×	
lechleri, Lampert,							×
Stereoderma unisemita, Ayres,	×						
Thyonidium drummondii, Thompson,			× *s*				
productum, Ayres,	× *s*						
pellucidum, Fleming,			×	×			
Orcula barthii, Troschel,	×	×		×			
luminosa, Lampert,		×					
Psolus regalis, Verrill,	×						
phantapus, Strussenfeldt,	×	×	×	×			
fabricii, Düben and Koren,	×	×		×	×		
squamatus, Düben and Koren,	×		×				
ephippifer, Wyville Thomson,						×	
antarcticus, Philippi,							×
poriferus, Studer,						×	
disciformis, n. sp.,							×
incertus, n. sp.,						×	
operculatus, Pourtalès,	× *s*						
Stichopus sitchaensis, Brandt,					×		
challengeri, n. sp.,						×	
Pseudostichopus mollis, n. sp.,						×	
villosus, n. sp.,							×
var. *violaceus*, n.,							×
Holothuria intestinalis, Ascanius and Rathke,			×	×			
magellani, Ludwig,							×
thomsoni, var. *hyalina*, n.,							×
ecalcarea, Sars,			×	×			
tremula, Gunner,			× ?	× ?			

TABLE II.—Atlantic Ocean.

	Scandinavia, south of the Arctic Circle.	British Islands and France.	Spain, Portugal, Azores Islands.	Mediterranean Sea.	East Coast of North America, from Maine to Florida, including Bermudas.	West Indies, incl. Florida, G. of Mexico, Pac. Coast of Central America and South America as far as the River Amazon.	West Coast of Africa, including Madeira, Canary Islands, &c.	East Coast of South America.
Rhabdomolgus ruber, Keferstein,		×						
Synapta lappa, J. Müller,						×	×	
polii, Ludwig,						×		
inhærens, O. F. Müller,	×	×		×	×		×	
gracilis, Selenka,					×			
roseola, Verrill,					×			
pourtalesii, Selenka,						×		
digitata, Montagu,		×	×	×			×	
benedeni, Ludwig,								×
tenera, Norman,	×	×						
hispida, Heller,				×				
vivipara, Œrsted,						×		
picta, n. sp.,					×			
abyssicola, n. sp.,					×			
Chirodota ferruginea, Verrill,					×			
lævis, Fabricius,					× ?			
rotifera, Pourtalès,						×		×
Myriotrochus rinkii, Steenstrup,	×							
Haplodactyla holothurioides, Cuvier,					×			
Trochostoma boreale, Sars,						×		
thomsonii, Danielsen and Koren,					× *n*			
turgidum, Verrill,					×			
ooliticum, Pourtalès,					×			
albicans, n. sp.,					× *n*			
sp. (?),								× *s*
Caudina arenata, Gould,					×			
Cucumaria grubii, von Marenzeller,				×				
quinquesemita, Selenka,					× ?			
planci, Brandt,		× ?	×	×				
lactea, Forbes,	×	×						
calcigera, Stimpson,					×			
elongata, Düben and Koren,	×	×	×	×				
tergestina, Sars,				×				
cucumis, Risso,				×				
hyndmanni, Thompson,	×	×		×				
kirchsbergii, Heller,				×				
frondosa, Gunnerus,	×	×			×			

TABLE II.—*continued.*

	Scandinavia, south of the Arctic Circle.	British Islands and France.	Spain, Portugal, Azores Islands.	Mediterranean Sea.	East Coast of North America, from Maine to Florida, including Bermudas.	West Indies, incl. Florida, G. of Mexico, East Coast of Central America and South America, as far as the River Amazon.	West Coast of Africa, including Madeira, Canary Islands, &c.	East Coast of South America.
Cucumaria frondosa, var. *mediterranea*, Semper,				×				
köllikeri, Semper,				×				
syracusana, Grube,				×			×	
punctata, Ludwig,						×		
nobilis, Ludwig,	× ?							
perspicua, Ludwig,	× ?							
minuta, Fabricius,		×		× ?				
assimilis, Düben and Koren,	×				×			
lefevrii, Barrois,		×						
saxicola, Brady and Robertson,		×						
cognata, Lampert,						×		
Echinocucumis typica, Sars,	×	×				×		
Colochirus pygmæus, n. sp.,								×
Thyone suspecta, Ludwig,						×		
surinamensis, Semper,						×		
briareus, Lesueur,					×	×		× ?
fusus, O. F. Müller,	×	×		×				
scabra, Verrill,					×			
raphanus, Düben and Koren,	×	×		×				
poucheti, Barrois,		×						
aurantiaca, Costa,				×			× *n*?	
gemmata, Pourtalès,					×	×		
pulcherrima, Ayres,					×			
peruana, Lesson,					×	×		
glabra, Ayres,					× *n*			
musculosa, Ayres,					× *n*			
inermis, Heller,				×				
elongata, Ayres,					× *n*			
pervicax, n. sp.,								×
Stereoderma unisemita, Ayres,					× *n*		× ?	
Thyonidium drummondii, Thompson,	×	×						
productum, Ayres,					× *n*			
pellucidum, Fleming,	×	×				×		
marionii, v. Marenzeller,				×				
parvum, Ludwig,								×
occidentale, Ludwig,						×		
flavum; Greeff,							×	

TABLE II.—*continued.*

	Scandinavia, south of the Arctic Circle.	British Islands and France.	Spain, Portugal, Azores Islands.	Mediterranean Sea.	East Coast of North America, from Maine to Florida, including Bermudas.	West Indies, incl. Florida, G. of Mexico, East Coast of Central America and South America, as far as the River Amazon.	West Coast of Africa, including Madeira, Canary Islands, &c.	East Coast of South America.
Thyonidium ehlersi, Heller,				×				
Orcula punctata, Selenka,					×			
Phyllophorus dobsoni, Bell,						×		
urna, Grube,				×				
granulatus, Grube,				×				
Psolus regalis, Verrill,					× *n*			
phantapus, Strussenfeldt,	×	×			× *n*			
fabricii, Düben and Koren,					× *n*			
squamatus, Düben and Koren,	× *n*	×			× *n*			
operculatus, Pourtalès,						×		×
murrayi, n. sp.,								×
antarcticus, Philippi,								×
Rhopalodina lagœniformis, Gray,							×	
Stichopus haytiensis, Semper,						×		
errans, Ludwig,						×		
möbii, Semper,						×		
tizardi, Théel,		×						
natans, Sars,	×							
regalis, Cuvier,		×		×				
maculatus, Greeff,							×	
assimilis, Bell,							×	
badionotus, Selenka,						×		
selenkæ, Barrois,		×						
Pseudostichopus villosus, n. sp.,					×			
Mülleria flavo-castaneâ, n. sp.,							×	
parvula, Selenka,						×		
agassizii, Selenka,						×		
Holothuria glaberrima, Selenka,						×		
lubrica, Selenka,						×		
catanensis, Grube,			×	×				
languens, Selenka,						×		
intestinalis, Ascanius and Rathke,	×	×						
surinamensis, Ludwig,						×		
tremula, Gunner,	×	×						
atra, Jæger,						×		
atra, var. *amboinensis*,						×		
grisea, Selenka,						×	×	×
mexicana, Ludwig,						×		

TABLE II.—*continued.*

	Scandinavia, south of the Arctic Circle.	British Islands and France.	Spain, Portugal, Azores Islands.	Mediterranean Sea.	East Coast of North America, from Maine to Florida, including Bermudas.	West Indies, incl. Florida, G. of Mexico, East Coast of Central America, and South America, as far as the River Amazon.	West Coast of Africa, including Madeira, Canary Islands, &c.	East Coast of South America.
Holothuria unicolor, Selenka,						•		
farcimen, Selenka,			×			×		
captiva, Ludwig,						×		
poli, Delle Chiaje,		×		×			×	
sanctori, Delle Chiaje,				×				
subditiva, Selenka,						×		
sulcata, Ludwig,						×		
occidentalis, Ludwig,						×		
helleri, von Marenzeller,				×				
tubulosa, Gmelin,		×	×	×			×	
stellati, Delle Chiaje,				×				
mammata, Grube,				×				
rigida, Selenka,						×		
princeps, Selenka,						×		
impatiens, Forskaal,				×		×		
arenicola, Semper,						×		
cubana, Ludwig,						×		
africana, n. sp.,				•			× *s*	
lactea, n. sp.,					× *n*	•		
murrayi (var. ?),					× *n*			
inornata, Semper,								×
nigra, Peach, Foot,		×						
enalia, Lampert,								×

TABLE III.—Indian and Pacific Oceans, including Australia, Sunda Islands, &c.

	Indian Ocean.			Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.	Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal, Moluccas Islands, Waygeoo, &c.	New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Anapta gracilis, Semper,			×							
Synapta kefersteinii, Selenka,		×					×			
tenuis, Quoy and Gaimard,							×			
beselii, Jæger,	×	×	×				×			
vittata, Forskaal,			×							
nigra, Semper,			×		×					
glabra, Semper,			×				×			
grisea, Semper,		×	×	×						
serpentina, J. Müller,	×		×							
godeffroyi, Semper,	×						×			
inhærens, O. F. Müller,		×								
indivisa, Semper,			×							
recta, Semper,			×							
albicans, Selenka,								×		
ooplax, von Marenzeller,						×				
reticulata, Semper,			×							
uncinata, Hutton,					×					
petersi, Semper,			×							
asymmetrica, Ludwig,			×							
dubia, Semper,			×							
incerta, Ludwig,			×							
var. *variabilis*, n.,						×				
bidentata, Woodward and Barrett,			×							
molesta, Semper,			×							
similis, Semper,			×							
bankensis, Ludwig,			×							
innominata, Ludwig,			×							
pseudo-digitata, Semper,			×							
distincta, von Marenzeller,			×			×				
autopista, von Marenzeller,						×				
inequalis, Hutton,					×					
verrilli, n. sp.,				×						
insolens, n. sp.,				×						
aculeata, n. sp.,						×				
challengeri, n. sp.,							×			

TABLE III.—*continued.*

	Indian Ocean.			Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.	Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal, Moluccas Islands, Waygeou, &c.	New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Chiridota japonica, von Marenzeller,					×	×				
studerii, Théel,							×			
australiana, Stimpson,					×					
dunedinensis, Jeffrey Parker,					×					
violacea, Peters, J. Müller,	×									
eximia, Haacke,	×									
rigida, Semper,			×							
incongrua, Semper,			×							
variabilis, Semper,			×	×		×				
vitiensis, Gräffe, Semper,							×			
dubia, Semper,			×							
panaensis, Semper,			×							
rubeola, Quoy and Gaimard,							×			
Ankyroderma roretzii, von Marenzeller,						×				
simile, n. sp.,						×				
marenzelleri, n. sp.,					×					
Haplodactyla molpadioides, Semper,			×							
australis, Semper,			×							
hyaloeides, Sluiter,			×							
Trochostoma arenicola, Stimpson,								×		
violacea, Studer,					×					
antarcticum, n. sp.,										× *s*
albicans, var. *glabra*, n.,					×					
Trochostoma sp. (?),										× *s*
Trochostoma sp.,										× *s*
Caudina ransonnetii, v. Marenzeller,						×				
coriacea, Hutton,					×					
caudata, Sluiter,			×							
Molpadia chilensis, J. Müller,										×
australis, Semper,				×	×					
Cucumaria godeffroyi, Semper,										×
maculata, Semper,			×		×					
crucifera, Semper,		×								
glaberrima, Semper,		×								
quinquesemita, Selenka,								×		
planci, Brandt,	× ?									
leonina, Semper,			×							
miniata, Brandt,								× ?		

TABLE III.—*continued.*

	Indian Ocean.			Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.	Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal, Moluccа Islands, Waygeoo, &c.	New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Cucumaria echinata, von Marenzeller,						×				
populifer, Stimpson,								×		
citrea, Semper,			×							
nigricans, Brandt,								×		
semperi, Bell,				×						
chronhjelmi, n. sp.,								× *n*		
improvisa, Ludwig,	× *s*									
ignava, Ludwig,					×					
africana, Semper,	×									
exigua, Ludwig,			×							×
tenuis, Ludwig,			×							
frauenfeldi, Ludwig,	× *s*		×							
californica, Semper,								×		
japonica, Semper,						×		× *n*		
frondosa, Gunnerus,			× ?					×		
dubiosa, Semper,										×
parva, Ludwig,										×
canescens, Semper,			×							
longipeda, Semper,			×			×				
conjungens, Semper,			×							
salmini, Ludwig,			×							
versicolor, Semper,			×							
panamensis, Verrill,									×	
mirabilis, n. sp.,			×		×					
capensis, n. sp.,	× *s*									
discolor, n. sp.,	× *s*									
thomsoni, Hutton,					×					
turbinata, Hutton,					×					
obunca, Lampert,						×				
sykion, Lampert,	× *s*									
abyssorum, var. *grandis*, n.,								× *s*		
var. *hyalina*, n.,								× *s*		
insolens, n. sp.,	× *s*									
multipes, n. sp.,						×				
posthuma, Lampert,	× *s*		×							
jägeri, Lampert,	× *s*									
Ocnus pygmæus, Semper,			×							
imbricatus, Semper,			×							

TABLE III.—*continued.*

	Indian Ocean.			Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.	Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal; Moluccas Islands, Waygeoo, &c.	New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Ocnus javanicus, Sluiter,			×							
molpadioides, Semper,			×							
typicus, n. sp.,			×							
Echinocucumis adversaria, Semper,			×							
Colochirus spinosus, Quoy and Gaimard,			×		×					
inornatus, v. Marenzeller,						×				
quadrangularis, Lesson,	× ?		×	×						
jagorii, Semper,			×							
tristis, Ludwig,	×			×						
minutus, Ludwig,				×	×					
australis, Ludwig,				×	×					
australis, var. *armatus*, v. Marenzeller,						×				
cylindricus, Semper,			×							
cucumis, Semper,			×			×				
peruanus, Semper,										×
tuberculosus, Quoyand Gaimard,			×	×	×	×	×			
viridis, Semper,			×							
colloradiatus, Haacke,	×									
propinquus, Haacke,	×									
violaceus, n. sp.,			×							
challengeri, n. sp.,				×						
Actinocucumis typica, Ludwig,			×	×						
difficilis, Bell,		×		×						
Pseudocucumis acicula, Semper,	×		×				×			
Amphicyclus japonicus, Bell,						×				
Eucyclus duplicatus, Lampert,										×
Thyone venusta, Semper,		×								
villosa, Semper,			×							
buccalis, Stimpson,				×	×					
rosacea, Semper,		×								
cunninghami, Bell,										× *s*
ovulum, Selenka,								× *s*		
mirabilis, Ludwig,				×						
sacella, Selenka,	×	×	×	×		×				
gibber, Selenka,									×	
okeni, Bell,					×					
chilensis, Semper,										×

TABLE III.—*continued.*

	Indian Ocean.			Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.	Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal, Moluccа Islands, Waygeoo, &c.	New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Thyone peruana, Lesson,										×
pedata, Semper,			×							
longidentis, Hutton,					×					
brevidentis, Hutton,					×					
meridionalis, Bell,					×					
fusus, var. *papuensis*, n.,				×						
curvata, Lampert,	×									
Stereoderma murrayi, Bell,		×								
validum, Bell,			×	×	×					
Thyonidium cebuense, Semper,			×							
magnum, Ludwig,			×							
caudatum, Hutton,					×					
japonicum, v. Marenzeller,						×				
schmeltzii, Ludwig,				×	×		×			
molle, Selenka,										×
rugosum, n. sp.,					×					
Orcula limaconotus, Brandt,						×				
tenera, Ludwig,		×					×			
hypsipyrga, von Marenzeller,						×				
cucumiformis, Semper,	×			×						
Phyllophorus perspicillum, Selenka,					×					
incompertus, n. sp.,					×					
ehrenbergii, Selenka,		×								
frauenfeldi, Ludwig,		×								
proteus, Bell,				×						
gracilis, Selenka,		×								
tenuis, Haacke,	×									
Psolus ornatus, Verrill,									×	
complanatus, Semper,			×							
boholensis, var. *pandanensis*, Semper,			×							
boholensis, Semper,			×							
fabricii, Düben and Koren,						×				
cataphractus, Selenka,					×					
ambulator, Bell,					×					
appendiculatus, Blainville,	×									
antarcticus, Philippi,										× *s*?
squamatus, Düben and Koren,										× *s*
Labidodemas semperianum, Selenka,							×			

TABLE III.—*continued.*

	Indian Ocean.		Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal, Moluccas Islands, Singapore, &c.	Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.		New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Labidodemas selenkianum, Semper,							×			
dubiosum, Ludwig,							×			
Stichopus chloronotus, Brandt,	×		×				×			
möbii, Semper,			×							
horrens, Selenka,	•						×			
godeffroyi, var. *b*, Semper,			×				×			
variegatus, Semper,	×	×	×	×			×			
fusus, Ludwig,										× s?
naso, Semper,			×							
godeffroyi, Semper,							×			
var. *pygmæus*, Semper,							×			
japonicus, Selenka,			×			×				
var. *typicus*, n.,						×				
kefersteinii, Selenka,								× s		
ananas, Jæger,			×	×			×			
armatus, Selenka,			× ?			×				
(?) *torvus*, n. sp.,									× s	
moseleyi, n. sp.,										× s
sordidus, n. sp.,					×					
paradoxus, Lampert,				×						
Pœlopatides confundens, n. sp.,									× s	
aspera, n. sp.,			×							
appendiculata, n. sp.,						×				
Pseudostichopus mollis, n. sp.,										× s
villosus, n. sp.,									×	
Mülleria nobilis, Selenka,	×	×	×				×			
hadra, Selenka,							×			
excellens, Ludwig,							×			
formosa, Selenka,	×		×							
obesa, Selenka,							×			
miliaris, Quoy and Gaimard,	×	×	×	×			×			
lecanora, Jæger,	×		×			×	×			
echinites, Jæger,	×	×	×				×			
parvula, Selenka,	×	×	×				×			
mauritiana, Quoy and Gaimard,	×	×	×				×			
guamensis, Quoy and Gaimard,							×			
Holothuria marmorata, Jæger,	×		×	×		×	×			
argus, Jæger,	×		×				×			

TABLE III.—*continued.*

	Indian Ocean.		Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal, Moluccas Island, Waygeoo, &c.	Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.		New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Holothuria vitiensis, Semper,							×			
tenuissima, Semper,		×	×				×			
koellikeri, Semper,	×						×			
clemens, Ludwig,			×				×			
similis, Semper,			×							
glaberrima, Selenka,								× s?	×	
lubrica, Selenka,			×					× s		
moebii, Ludwig,	×		×							
erinaceus, Semper,			×	×			×			
paradoxa, Selenka,							×			
marenzelleri, Ludwig,						×				
languens, Selenka,									×	
pertinax, Ludwig,							×			
imitans, Ludwig,							×			
dietrichii, Ludwig,			×	×						
modesta, Ludwig,		×		×						
gräffei, Semper,			×				×			
flavo-maculata, Semper,			×				×			
fusco-coerulea, n. sp.,							×			
pulchella, Selenka,	×	×	×			×	×			
pervicax, Selenka,	×	×	×		×		×			
atra, Jæger,	×	×	×				×			
atra, var. *amboinensis*,	×		×				×			
pulla, Selenka,	×?		×							
pyxis, Selenka,			×							
inornata, Semper,								× s		
edulis, Lesson,	×	×	×	×?			×			
monacaria, Lesson,	×		×		×		×			
decorata, v. Marenzeller,	×					×				
macleari, Bell,	×			×						
humilis, Selenka,							×			
vagabunda, Selenka,	×	×	×	×			×			×
lagœna, Haacke,	×	×								
difficilis, Semper,	×						×			
strigosa, Selenka,	×	×								
curiosa, Ludwig,			×	×			×			
fusco-cinerea, Jæger,		×	×			×	×			
fusco-rubra, n. sp.,							×			

TABLE III.—*continued.*

	Indian Ocean.		Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.	Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal, Molucca Island, Waygeoo, &c.	New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Holothuria signata, Ludwig,							×			
pardalis, Selenka,	×	×	×	×	×	×	×			
subditiva, Selenka,									×	
lineata, Ludwig,	×	×		×						
peregrina, Ludwig,				×			×			
insignis, Ludwig,	×	×	×	×						
inhabilis, Selenka,							×			
rugosa, Ludwig,			×				×			
discrepans, Semper,							×			
immobilis, Semper,	×		×							
cæsarea, Ludwig,							×			
samoana, Ludwig,		× ?					×			
notabilis, Ludwig,				×						
pleuripus, Haacke,	×									
bowensis, Ludwig,				×						
rigida, Selenka,	×	×					×			
coluber, Semper,			×							
chilensis, Semper,										×
kubaryi, Ludwig,							×			
impatiens, Forskaal,	×	×	×	×			×		×	
gracilis, Semper,	×		×				×			
arenicola, Semper	×	×	×			×	×			
verrucosa, Selenka,	×						×			
scabra, Jæger,	×	×	×	×			×			
aculeata, Semper,			×							
fusco-punctata, Jæger,			×							
albiventer, Semper,	×	×	×							
martensii, Semper,			×	×						
squamifera, Semper,		×	×				×			
minax, n. sp.,						×				
spinifera, n. sp.,			×							
ocellata, Jæger,				×						
lactea, n. sp.,					×					
thomsoni, n. sp.,						×		× *n*		
murrayi, n. sp.,								× *s*		
var. *parva*, n.,							×			
holothuroides, Sluiter,			×							
occidentalis, Ludwig,	×									

TABLE III.—*continued.*

	Indian Ocean.			Australia.		Pacific Ocean.				
	East Coast of Africa to Cape of Good Hope, incl. Madagascar, Mauritius, &c.	Red Sea and Gulf of Aden.	Sunda Islands, Philippine Islands, China Sea, and Bay of Bengal, Moluca Island, Waygoo, &c.	New Guinea, North Australia, and Queensland.	New Zealand, South Australia, New South Wales, and Victoria.	Japan Islands, Yellow Sea, and Bonin Island.	Polynesia.	West Coast of North America.	West Coast of Central America.	West Coast of South America.
Holothuria monosticha, Haacke,	×									
aphanes, Lampert,		×								
remollescens, Lampert,		×								
truncata, Lampert,				×						
klunzingeri, Lampert,		×								
parva, Lampert,	×									

Notes.—In the tables most of the doubtful species have been excluded.
×*n* or ×*s* signify that the species is found in the northern or southern part of the province indicated by the column.
× placed "on a line" means, that only the ocean or land is known, but no definite locality is assigned.

The above Tables certainly communicate a fairly correct idea of the distribution of the Holothurioidea, so far as is at present known, but it must be remembered that great parts of the world have not yet been explored, and that every year new forms are found on our own coast, proving that our present knowledge of the geographical distribution is very incomplete, and does not enable us to speak with any confidence. Considering this, as well as the fact that scarcely anything is known about fossil Holothurids, only a few general conclusions, which seem to be established, may be mentioned.

With respect to the arctic and antarctic regions, the observations hitherto made seem to establish that not a single species of the Holothurioidea is common to both seas. Notwithstanding this the shallow-water fauna of the two regions possesses much the same features. Thus the northern forms *Cucumaria frondosa, Trochostoma borealis, Psolus squamatus, Psolus fabricii, Holothuria intestinalis*, &c., are represented in the Antarctic Sea by *Cucumaria lævigata, Cucumaria crocea, Trochostoma violacea, Psolus ephippifer, Psolus antarcticus*, and *Holothuria magellani*. I have had all these forms at my disposal, with the exception of *Holothuria magellani*, and they appear to be distinct from one another, though the distinguishing characters, it must be confessed, often seem to be rather inconsiderable and possibly not of specific value. It is, however, of importance not to neglect such small characters, which unquestionably have a much greater consequence than may be at first supposed. According to my opinion, every example proving that the arctic and antarctic shallow-water faunæ are different is of value, for I cannot conceive how it is possible that they can have animals which are

entirely similar. Of course, I do not take into consideration such forms as pass their existence on the bottom of the deep-sea or at the surface of the ocean. It appears scarcely probable that the shore fauna of two regions so far separated from each other as the arctic and antarctic seas, has any direct exchange of forms at the present epoch, so as to allow the same species, in its larval or adult state, to pass from one pole to the opposite without settling at interjacent regions. In brief, I do not believe that at the present epoch the arctic shallow-water fauna can directly originate from the antarctic, or *vice versa*.

On the other hand, it is a fact that the two faunæ in question resemble each other very closely, and, with regard to the Holothurids, that several forms occur in the arctic sea which are most closely allied to those in the antarctic. I am inclined to suppose that the progenitors of these Holothurids have had a much wider distribution during a past period, that altered physical conditions, a keener struggle for existence, &c., under the tropic and the temperate zones have effected their extinction, or their migration towards the polar seas, or even produced changes in their organisation and general appearance so marked, that their descendants which still remain in the tropical zones present themselves as species distinct from the original, and finally that the polar seas with their more uniform physical conditions, allowed them and their descendants to live there and to develop slowly but continuously after almost the same plan.

The genus *Psolus* offers an instructive example of forms which are distributed over all seas from the Arctic Ocean to the Antarctic, and which are so very little differentiated that we scarcely acknowledge them as distinct species. Thus the northern species, *Psolus squamatus* and *Psolus fabricii* pass imperceptibly into *Psolus operculatus*, *Psolus complanatus*, and several other tropical or subtropical forms, which in their turn are replaced towards the antarctic regions by *Psolus antarcticus* and *Psolus ephippifer*, &c. But it must be observed that all these forms of *Psolus*, though they apparently present great similarities, are nevertheless distinguishable, though the differences may or may not be of specific value. It appears pretty evident that they are all descendants from the same ancestors, which may have had their origin in the polar seas or in the tropic or subtropic oceans, and that they, in their wide dispersion, have sustained very well the influence of altered and very various physical conditions in different regions of the world. But, of course, different physical conditions and an altered mode of life have caused some small deviations in internal and external organisation.

With regard to the remaining species of Holothurids mentioned above, I think the same is or has been the case. Forms intermediate between those in the arctic and those in the antarctic seas, are either still living in interjacent regions, having undergone alterations of a more or less adaptive nature, or they have succumbed.

As a fact, numerous arctic forms of animals are "circumpolar," and among the Holothurioidea, *Myriotrochus rinckii*, *Chirodota lævis*, *Cucumaria calcigera*, *Cucumaria*

frondosa, *Poslus fabricii*, and possibly *Psolus phantapus*, appear to be distributed round or nearly round the pole.

Only a few Holothurids, viz., *Holothuria atra* and *Holothuria impatiens*, are with certainty known to be "circumequatorial," and *Holothuria occidentalis*, *Holothuria rigida*, *Mülleria parvula*, and several others may doubtless be proved to have the same wide distribution. Considering the great conformity between the Holothurids in the Indian and Pacific Oceans, it does not appear improbable that an exchange of forms is still going on between the Pacific and Atlantic Oceans, and that this takes place round the south coast of Africa. There is great probability that the currents in the Atlantic Ocean, as well as in other seas, transport animals in the larval state from one coast to another. No shallow-water Holothurid is, of course, known to be completely cosmopolitan.

Though our present knowledge with regard to the distribution of the Holothurids is too insufficient to establish definite features of the different oceans, a few points which are probably accurate may be mentioned.

The Arctic Ocean.—The Synaptidæ, in regard to the number of species, are very poorly represented. The genus *Synapta* has only a single representative, *Synapta inhærens*, and it, besides being very rare, is not a true arctic form. *Chirodota lævis* and *Myriotrochus rinckii*, on the contrary, are present in great numbers, and the latter as well as *Trochoderma elegans*, both very strange forms, may be said to give a character to the arctic fauna. Among the Molpadidæ, *Eupyrgus scaber* is singular in general appearance, and peculiar to the arctic ocean. The Dendrochirotæ have about twenty-five representatives, but not a single one of a remarkable shape except *Echinocucumis typica*, which is not a true arctic form. However, *Cucumaria frondosa*, one of the largest known Holothurids, abounds in several parts of the Arctic Sea, and gives the fauna a singular character, and the same may be said in a higher degree of the genus *Psolus*, which attains its maximum development in the northern seas, the three species *Psolus phantapus*, *Psolus fabricii*, and *Psolus squamatus*, being the largest known forms of this genus. The Aspidochirotæ are nearly absent, only two or three forms, *Holothuria intestinalis*, *Holothuria tremula* (?) and *Holothuria ecalcarea*, having been with certainty found in the southern part of the arctic region. With a few exceptions, *Cucumaria frondosa*, *Holothuria tremula* and *Trochstoma boreale*, the northern Holothurids are almost devoid of colouring matters in the integument.

The *Antarctic Fauna* is too insufficiently known to admit of any general statements.

The Atlantic Ocean.—The Atlantic Ocean, which can be divided into several regions, the North Atlantic, the South Atlantic, the West Indian and the Mediterranean, contains, as may be seen from the tables, a much greater number of shallow-water Holothurids than the Arctic Sea, but scarcely one can be said to characterise it. Of course there are many species hitherto known only from the Atlantic Ocean, but they do not in general present

any peculiar features, nor do they particularly abound. The very remarkable *Rhopalodina* has been hitherto only dredged at a single locality. In different regions different forms predominate; thus the Aspidochirotæ abound in species at the West Indies and also in other tropical or subtropical zones. The Mediterranean has a Holothurian fauna very different from that of the West Indies, but reminding one in several respects of that of the British and Scandinavian coasts.

The Indian and Pacific Oceans.—Considering the fact that while about forty-two species and varieties are known from the Arctic Ocean, thirty-two from the Antarctic, one hundred and thirty-five from the Atlantic and Mediterranean, but no less than about three hundred and five from the Indian and Pacific Oceans, there seems to be sufficient reason for the opinion that the Holothurids attain their maximum development in these latter seas. Here, as well as in the Atlantic Ocean, the tropical and temperate regions are the richest, while a diminution in the abundance of Holothurian life takes place towards the arctic and antarctic regions. The fact that among eighty-nine species hitherto known from the Indian Ocean, forty-nine are also found in the Pacific, evidently proves the great similarity between the two oceans, a similarity which will certainly be more striking when a greater part of the Indian Ocean is explored.

The genus *Synapta* is represented by no less than thirty-four species, of which some attain an enormous length; the large *Synapta beselii*, *Synapta glabra*, *Synapta grisea*, &c., are not only by their size, but even by their colour and external appearance, in a high degree characteristic of the oceans in question. The genera *Actinocucumis*, *Pseudocucumis*, *Amphicyclus* and *Eucyclus* are known only from these oceans, and show that those Dendrochirotæ which are marked by possessing more than ten tentacles, have been subjected to greater variations here than in the Atlantic Ocean. The singular genus *Colochirus* is very characteristic of the Holothurians of these oceans, and gives to them a peculiar stamp, for among eighteen known species, seventeen belong to the Indian and Pacific Oceans. Among the Aspidochirotæ, *Mülleria*, *Stichopus* and *Holothuria* abound in all places, and are represented by a very much greater number of forms than is the case in the Atlantic Ocean.

APPENDIX.

In December 1885, after the greater part of my Report had been printed off, Lampert's valuable work on the Holothurioidea appeared, necessitating some additions to this Report. In order to complete my monograph I subjoin a survey of the new forms described by Lampert; and the new localities mentioned in his work, of forms already known, are inserted in the geographical tables.

Holothuria anapinusa, Lampert, 1885.

Ventral surface with numerous closely placed pedicels, indistinctly arranged in longitudinal series. Dorsal surface with papillæ of variable size; along each side of the body, on the line of junction between the dorsal and ventral surfaces, there is a row of about six large papillæ with smaller ones between. A circle of papillæ surrounds the twenty tentacles. Deposits—tables alone, having the disk smooth on the margin, and regularly pierced with eight holes; their spire is built up of four rods and one transverse beam, and terminates in twelve to sixteen teeth.

Habitat.—Sörres Island (Lampert).

Considering the fact that the genital organs are unknown, it is uncertain whether this species belongs to the genus *Holothuria* or to *Stichopus*.

Holothuria aphanes, Lampert, 1885.

Ventral surface with pedicels arranged in three longitudinal double rows. Dorsal surface with minute, scattered papillæ, smaller than the pedicels. Tentacles (?). Deposits—tables alone, having the rather large smooth disk pierced with eight peripheral holes; their spire is built up of four rods and one transverse beam, and terminates in eight teeth. Besides these tables the pedicels possess others with a larger disk, a longer spire and several transverse beams.

Habitat.—Cosseir (Lampert).

According to Lampert, the single specimen examined is probably a young one.

Holothuria remollescens, Lampert, 1885.

Pedicels all over the body, closely placed on the ventral and sparsely on the dorsal surface. Tentacles twenty. Deposits—smooth buttons of the usual shape

with six holes; and tables which have the smooth disk pierced with four central and about twelve peripheral holes, and supporting a spire composed of four rods and one transverse beam, and terminating in about twelve teeth. Among these tables others are scattered which have the spire much longer, provided with three to four transverse beams, and terminating in only four teeth.

Habitat.—Cosseir (Lampert).

Holothuria truncata, Lampert, 1885.

Rather large papillæ all over the body. Tentacles eighteen. Deposits—smooth buttons of the usual shape with six holes; and very solid tables, which have the smooth disk perforated by eight peripheral holes and supporting a spire which is built up of four rods and one transverse beam, and which terminates in so great a number of teeth that the top of the spire becomes almost as wide as the disk itself.

Habitat.—Queensland (Lampert).

Holothuria klunzingeri, Lampert, 1885.

Sparsely scattered pedicels all over the body. Tentacles twenty. Deposits—buttons with six holes, and two knobs on the middle beam; and tables of the usual shape with small holes on the disk, and spines of varying number and size on its margin. The spire is composed of four rods and one transverse beam, and terminates in eight teeth. Sometimes the spire seems to be rather poorly developed.

Habitat.—Cosseir (Lampert).

The species is possibly not distinct from Ludwig's *Holothuria notabilis*.

Holothuria enalia, Lampert, 1885.

Ventral surface with irregularly scattered pedicels; dorsal surface with very sparsely placed small papillæ. Tentacles small and withdrawn into the body. Deposits—small, fenestrated plates of irregular shape; and tables completely devoid of disks or possessing simple annular ones. The spire is composed of four rods held together at their middle by one transverse beam, but not united at their free ends, which are simple, devoid of spines or teeth, and directed outwards.

Habitat.—Bahia (Lampert).

The species is nearly allied to *Holothuria atra* and *Holothuria grisea*, &c.

Holothuria parva, Krauss, Lampert, 1885.

Habitat.—Natal (Lampert).

The species scarcely seems to be distinguished from Semper's *Holothuria crinaceus*. Lampert, however, says that its deposits consist of short, solid, thick rods, pro-

vided with short, conical, simple spines, which not unfrequently present a great resemblance to those in *Phyllophorus frauenfeldi*, so that the spines are collected at the middle and at each end of the rods.

Stichopus paradoxus, Lampert, 1885.

Pedicels scattered all over the body, no arrangement in longitudinal series being discernible. Tentacles twenty. Deposits—tables with the disk smooth or irregularly spinous on the margin, pierced with four central holes and an irregular circle of peripheral ones, and supporting a spire which is built up of four rods and one transverse beam, and carries about ten large teeth on the margin of the very wide annular top; smooth buttons always with three pairs of holes, but not unfrequently asymmetrical; also C-shaped bodies.

Habitat.—New Holland (Lampert).

This species seems to be very well defined. No *Stichopus* was previously known which has pedicels on both the dorsal and ventral surfaces. Nor were the three kinds of deposits ever found before in the same species.

Cucumaria posthuma, Lampert, 1885.

Habitat.—Java, Table Bay and Cape of Good Hope (Lampert).

Synonymous with *Cucumaria frauenfeldi*, Ludwig, 1882. Compare page 109 of this Report. At the middle of the body the pedicels form three rows along each ambulacrum.

Cucumaria jägeri, Krauss, Lampert, 1885.

Body ovate, ventral pedicels arranged in four or five rows on each ambulacrum, dorsal pedicels in three or four. Deposits like those in *Cucumaria echinata*, but devoid of the long, characteristic, outwardly-directed spine; the deposits are very solid and covered with closely-placed knobs. Pedicels devoid of terminal plates. Calcareous ring robust and devoid of posterior prolongations.

Habitat.—Natal (Lampert).

Cucumaria obunca, Lampert, 1885.

Body-form like that in *Cucumaria cucumis*. A double row of about thirty retractile pedicels in each ambulacrum. Deposits—tables, consisting of an irregularly oval, smooth disk with undulated margin, perforated with four holes, and having the spire reduced to two knobs. Calcareous ring very fine, devoid of prolongations posteriorly.

Habitat.—Hakodadi, Japan (Lampert).

Cucumaria sykion (*Semperia*), Lampert, 1885.

Ventral surface with pedicels only on the ambulacra, placed in four or five irregular rows on each. Dorsal surface with pedicels on the ambulacra as well as on the interambulacra, though those on the latter are smaller. Deposits like those in *Cucumaria dubiosa*, Semper. Calcareous ring devoid of bifurcate prolongations posteriorly.

Habitat.—Algoa Bay (Lampert).

This species must be very nearly related to *Cucumaria dubiosa* and *Cucumaria köllikeri*, but is distinguished from them principally by the arrangement of the pedicels.

The genus *Semperia*, founded by Lampert, comprises all forms of Cucumariæ which have two or more rows of pedicels on the ambulacra, and also scattered ones on all the interambulacra, or on some of them. He retains the old name of the genus for all those species which have the pedicels arranged in two or more rows on the ambulacra alone. For my own part, I cannot understand the necessity of this separation, considering the very natural affinity between all or most of the species in question. Besides, it is the fact that a good many of those forms which would be referred to "*Semperia*," when they are young are provided with pedicels only on the ambulacra.

As is known, Semper grouped the dendrochirotous Holothurians under the three subfamilies, Stichopoda, Gastropoda, and Sporadipoda, according to the arrangement of the pedicels. Bell, in his paper on *Amphicyclus*, in 1884, gave particular attention to the position and number of the tentacles in the Dendrochirotes, and proposed the name "polychirote Dendrochirotæ" for those forms which have more than ten tentacles, and "decachirote Dendrochirotæ" for those with only ten tentacles. The views of Bell were recently adopted and further explained by Lampert, who places the dendrochirotous Holothurians under the two new subfamilies of "Decachirotæ" and "Polychirotæ," according as the tentacles are ten or more than ten; moreover, he divides the latter subfamily into two groups, "Monocyclia" and "Amphicyclia," according as the tentacles form a single or a double crown. I refrain from offering any opinion on the validity of this division, which in several respects, it must be confessed, seems to be better than that of Semper, but in others, especially from the view of natural relationship, can scarcely be satisfactory.

Cucumaria cognita (*Semperia*), Lampert, 1885.

Body tapered towards each extremity. Pedicels arranged in a double row along each ambulacrum, and also scattered over all the interambulacra at the swollen middle portion of the body. Towards the extremities of the body, where the interambulacra are naked, the pedicels become transformed into small, conical, white, rough papillæ; terminal plates absent. Deposits—elongated, smooth plates of a somewhat asymmetrical appearance, perforated with one or two irregular

rows of holes, thus resembling those in *Cucumaria tergestina*. Calcareous ring like that in *Cucumaria conjungens*.

Habitat.—Cuba and Fernando di Noronha (Lampert).

Thyone curvata, Lampert, 1885.

Body fusiform. Pedicels equally distributed all over the body. Deposits—roundish plates with about ten obtuse, rather large teeth round the margin, with four holes and four conical spines on the upper surface (=incomplete tables); also minute rosettes. Each of the ten pieces of the calcareous ring is composed of small parts, and the radial are prolonged into a posterior bifurcation.

Habitat.—Zanzibar (Lampert).

Thyone (*Thyonidium ?*) *lechleri*, Lampert, 1885.

Pedicels rather more densely placed on the ventral surface than on the dorsal. An arrangement of the pedicels in rows traceable along the ambulacra. Deposits—more or less irregularly roundish or oval, smooth swollen bodies, which are usually devoid of holes, but sometimes are pierced with one small hole or more, and present a concentric structure. All the ten pieces of the calcareous ring are almost equal, and each has a bifurcate prolongation posteriorly.

Habitat.—Strait of Magellan (Lampert).

From the scarcity of materials Lampert could not tell the number of tentacles; he is therefore dubious whether the species is a *Thyone* or a *Thyonidium*.

Orcula luminosa, Lampert, 1885.

Pedicels equally distributed all over the body. Deposits—large scattered tables, consisting of a disk pierced with four central holes and about eight peripheral ones, and carrying at each of its angles a short process; the robust spire is composed of four rods and one transverse beam; its top is irregularly spinous. Calcareous ring composed of ten simple pieces, devoid of bifurcate prolongations posteriorly.

Habitat.—Greenland (Lampert).

Pseudocucumis intercedens, Lampert, 1885.

Tentacles eighteen, in two crowns, those in the outer crown thirteen in number, unequal, and usually slightly larger than the five others which form the inner crown. Pedicels only present on the ambulacra, where they are irregularly placed, four or five side by side. Deposits—crowded tables like those in *Cucumaria versicolor*, consisting of an irregular, oval, smooth disk, usually pierced with four holes, and a long spire built up of two rods, and terminating in two long diverging teeth. Sometimes the disk becomes more elongated and provided with more than four holes. The spire itself shows two to four perforations.

Calcareous ring of ten simple pieces, devoid of prolongations posteriorly; the interradial carry anteriorly one point, the broad radial have four.

Habitat.—(?).

Genus Eucyclus, Lampert, 1885.

Tentacles twenty, in two crowns, each crown composed of ten equal tentacles; those of the inner crown smaller and radial in position, those of the outer crown larger and interradial. Pedicels equally distributed all over the body. Calcareous ring like that in *Thyone chilensis*, composed of only five simple pieces, devoid of prolongations posteriorly.

Eucyclus duplicatus, Lampert, 1885.

Body ovate, slightly curved. Deposits—sparsely scattered, small, tuberculated rods, slightly enlarged and usually perforated at each end, thus resembling those in *Thyone chilensis*.

Habitat.—Callao, Peru (Lampert).

A detailed comparison of the descriptions of *Eucyclus duplicatus* and *Thyone chilensis* clearly shows that the two forms are very nearly related, and that the only points of distinction are the number and arrangement of the tentacles. Supposing that Semper is right in stating the number of tentacles to be ten in his *Thyone chilensis*, it remains unexplained how it is possible that species of two different genera, which also belong to different subfamilies, can be developed in "every detail" like one another. For my own part I am very much tempted to think that Semper has made a mistake in counting the tentacles, in which case the two forms will be identical, but if he be right, there is still weighty reason for placing the two forms side by side, in spite of the differences in the number of tentacles, because they present the most obvious similarity in every other respect. I fear that the individual variations in regard to the tentacles in many Dendrochirotes may be much more extensive than has been hitherto supposed, and that this variation principally takes place in the "polychirote" Dendrochirotes. In all those Dendrochirotes, on the contrary, which are characterised by possessing only ten tentacles, *these* appear to be almost constant in number, size, and position. From deficient knowledge in these respects it does not seem very suitable at present to found the subfamilies above mentioned merely on the differences in the tentacles.

Lampert has associated with the following three forms, incompletely described by Rathbun, Anderson and Barrois, the names of their respective discoverers:—

Holothuria rathbunii, Lampert, 1885 = *Holothuria*, sp. mihi, p. 239.
Colochirus andersoni, Lampert, 1885 = *Holothuria*, sp. mihi, p. 240.
Semperia barroisi, Lampert, 1885 = *Thyone fusus*, mihi, p. 134.

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PLATE I.

PLATE I.[1]

Fig. 1. *Synapta verrilli*, n. sp. *a*, anchor; *b*, anchor-plate; *c*, calcareous ring; *d*, miliary granules.

Fig. 2. *Synapta aculeata*, n. sp. *a–d*, anchors of various appearances; *e*, anchor-plate; *f*, miliary granules.

Fig. 3. *Synapta insolens*, n. sp. *a*, anchor; *b*, anchor-plate; *c*, miliary granules.

Fig. 4. *Synapta challengeri*, n. sp. *a*, anchor; *b*, anchor-plates; *c*, miliary granules; *d*, calcareous ring.

Fig. 5. *Synapta incerta*, var. *variabilis*, nov. Anchor-plates.

Fig. 6. *Synapta glabra*, Semper. *a*, anchor; *b*, anchor-plate; *c*, rosette-shaped bodies.

Fig. 7. *Synapta lappa*, Müller. *a*, anchor; *b*, anchor-plate; *c*, rosette-shaped bodies.

Fig. 8. *Synapta distincta*, von Marenzeller. *a*, anchor-plate; *b*, ×-shaped miliary granules; *c*, calcareous ring.

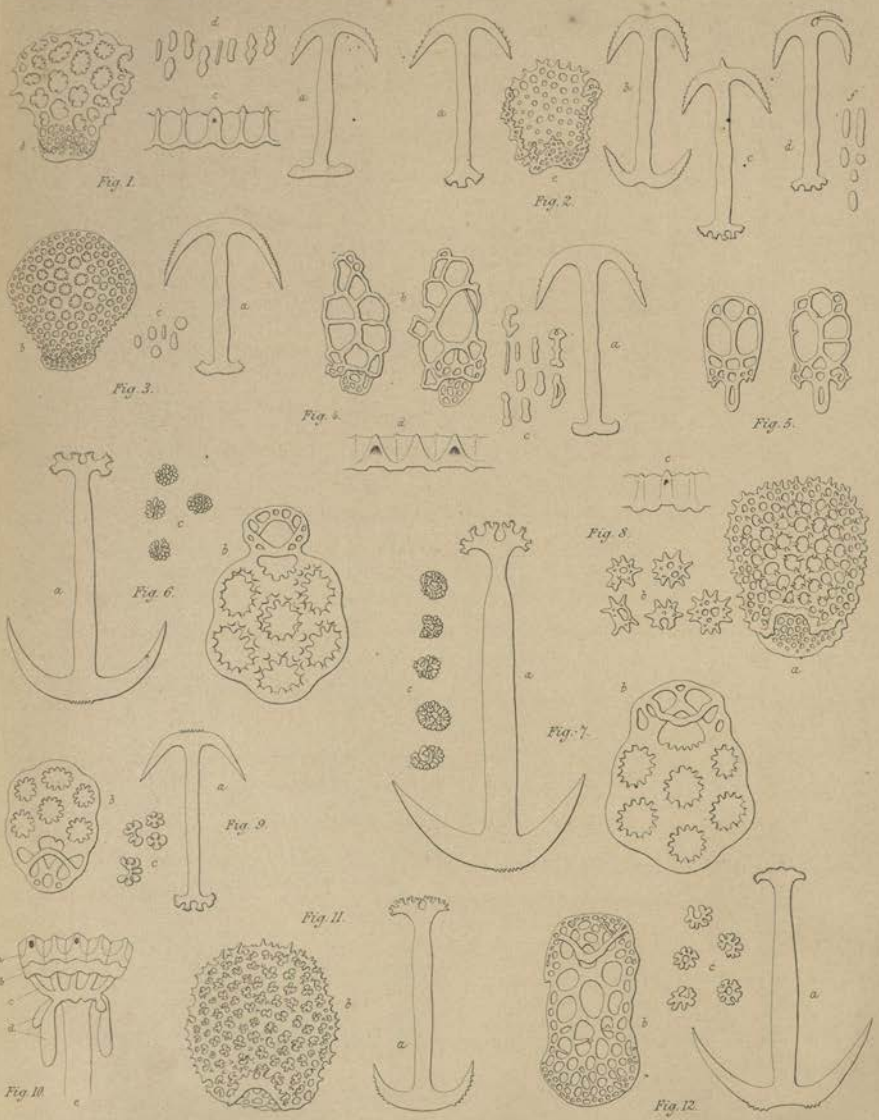
Fig. 9. *Synapta picta*, n. sp. *a*, anchor; *b*, anchor-plate; *c*, incomplete rosette-shaped granules.

Fig. 10. *Synapta picta*, n. sp. *a*, calcareous ring; *b*, ring made up of connective tissue; *c*, tentacular canals; *d*, Polian vesicles; *e*, œsophagus.

Fig. 11. *Synapta abyssicola*, n. sp. *a*, anchor; *b*, anchor-plate.

Fig. 12. *Synapta beselii*, Jæger. *a*, anchor; *b*, anchor-plate; *c*, rosette-shaped granules.

[1] Where no measurements are given, the figures are more or less strongly magnified. The natural size of the deposits is always mentioned in the text.



1, SYNAPTA VERRILLI, n.sp 2, SYNAPTA ACULEATA, n.sp 3, SYNAPTA INSOLENS, n.sp 4, SYNAPTA CHALLENGERI, n.sp
5, SYNAPTA INCERTA, var. VARIABILIS, n. 6, SYNAPTA GLABRA, Semper. 7, SYNAPTA LAPPA, Müller
8, SYNAPTA DISTINCTA, von Marenzeller. 9-10, SYNAPTA PICTA, n.sp. 11, SYNAPTA ABYSSICOLA, n.sp
12, SYNAPTA BESELII, Jæger.

PLATE II.

PLATE II.

Fig. 1. *Chirodota purpurea*, Lesson. *a*, wheel; *b*, miliary granules.

Fig. 2. *Chirodota contorta*, Ludwig. *a*, wheel; *b*, sigma-shaped deposits.

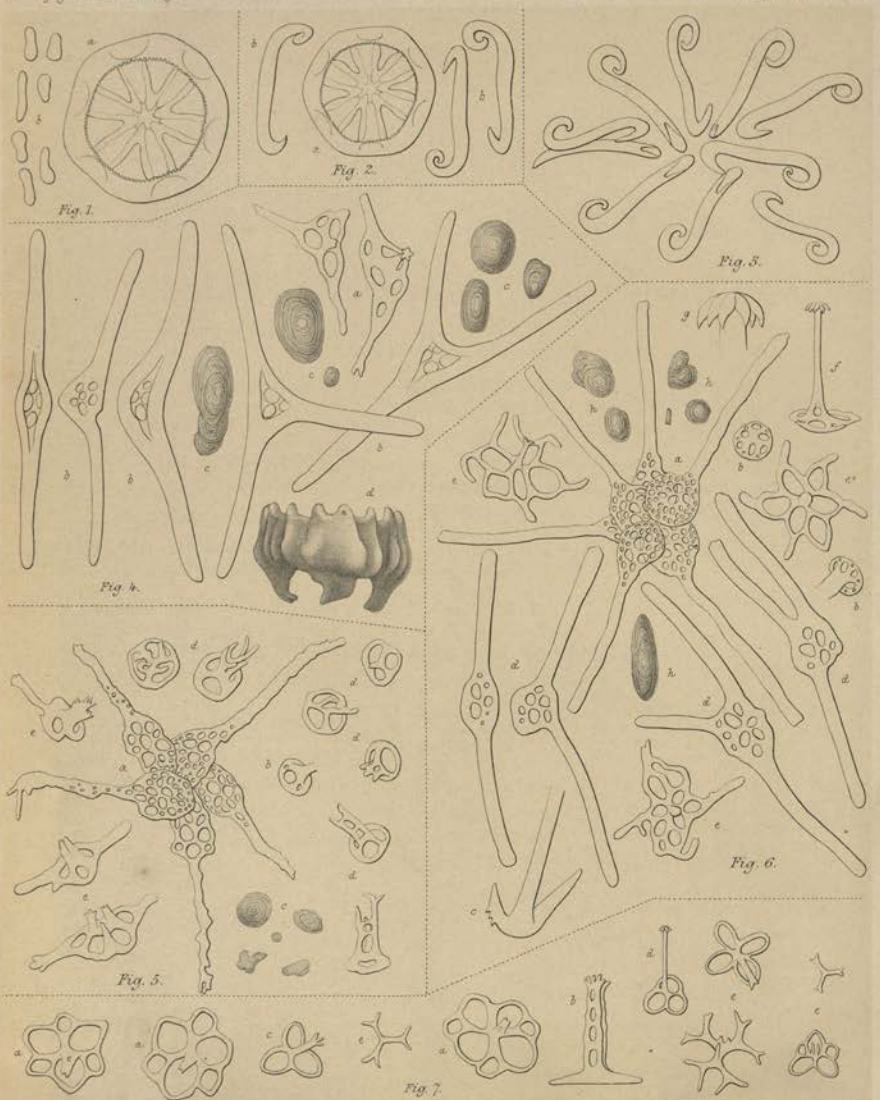
Fig. 3. *Chirodota japonica*, von Marenzeller. Group of sigma-shaped deposits.

Fig. 4. *Trochostoma violaceum*, Studer. *a*, small irregular, table-like deposits; *b*, large fusiform rods; *c*, wine-coloured deposits; *d*, calcareous ring.

Fig. 5. *Ankyroderma simile*, n. sp. *a*, stellate aggregation of spoon-like rods; *b*, basal portion of the central anchor-shaped rod; *c*, reddish deposits; *d*, table-like deposits; *e*, tables from the posterior extremity of the body.

Fig. 6. *Ankyroderma danielsseni*, n. sp. *a*, stellate aggregation of spoon-like rods; *b*, basal portions of the central anchor-shaped rod; *c*, the free end of the anchor; *d*, fusiform rods; *e*, small irregular plates with a central spine; *f*, minute deposits with the long central spine carrying hooks; *g*, the free end of such a spine, highly magnified.

Fig. 7. *Trochostoma antarcticum*, n. sp. *a*, tables with a less-developed spire; *b*, side view of a table with longspire and several transverse beams; *c* and *e*, different developmental stages of tables; *d*, minute table with hooks at the free end of the long spine.



H. Théel del. F. Huth, Lith. Inst.

1, CHIRODOTA PURPUREA, Lesson. 2, CHIRODOTA CONTORTA, Ludwig. 3, CHIRODOTA JAPONICA, von Marenzeller.
4, TROCHOSTOMA VIOLACEUM, Studer. 5, ANKYRODERMA SIMILE, n. sp. 6, ANKYRODERMA DANIELSSENI, n. sp.
7, TROCHOSTOMA ANTARCTICUM, n. sp.

PLATE III.

PLATE III.

Fig. 1. *Ankyroderma marenzelleri*, n. sp. *a*, tables; *c*, basal portion of an anchor; *d*, the free end of an anchor; *e*, anchor-plates; *f*, smaller and larger yellowish or brownish deposits; *g*, anchor-plate which has begun to change in colour, a part of it still remaining colourless. Branched figures at left hand side show developmental stages of tables.

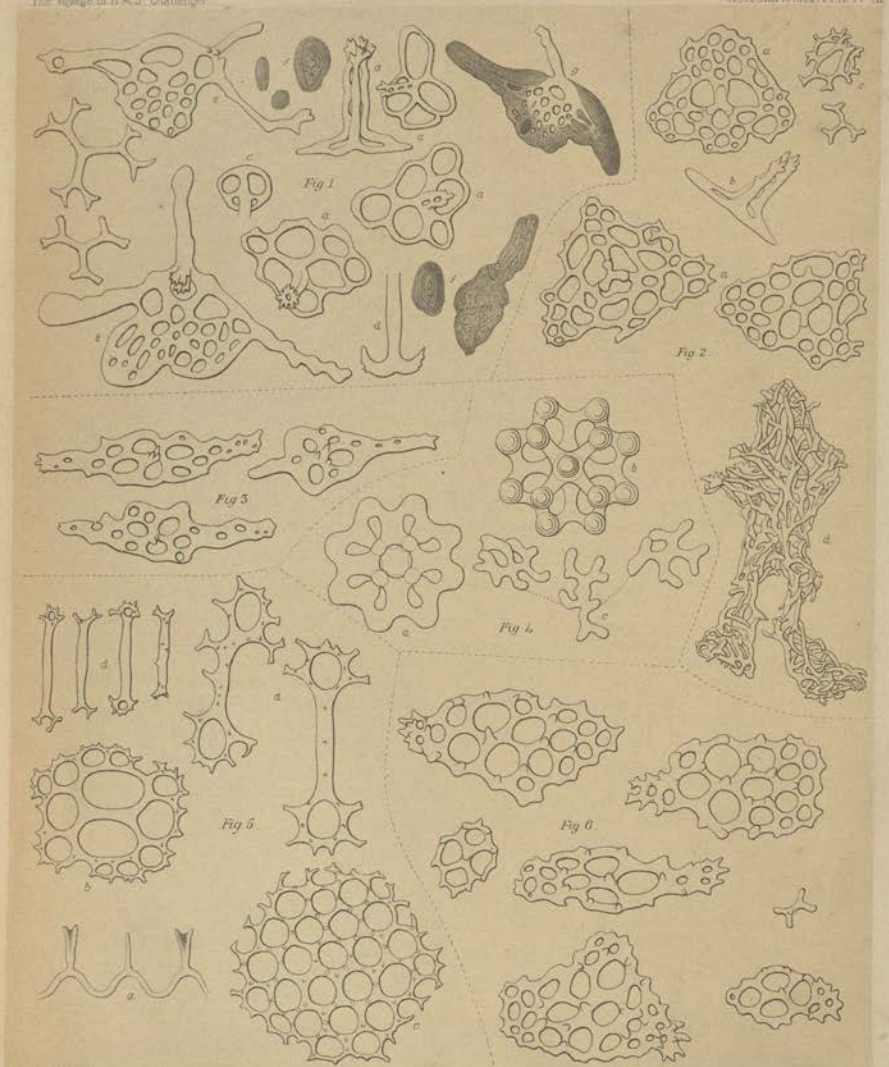
Fig. 2. *Trochostoma albicans*, n. sp. *a*, tables, seen from above; *b*, side view of a table; *c*, developmental stages of tables; *d*, calcareous network, forming an anal tooth.

Fig. 3. *Trochostoma* sp. (?). Different kinds of table-like plates.

Fig. 4. *Caudina coriacea*, Hutton. *a*, wheel- or cup-shaped deposit, seen from the under surface; *b*, the same, seen from above; *c*, deposits from the anal papillæ.

Fig. 5. *Cucumaria lævigata*, Verrill. *a*, calcareous ring; *b*, calcareous plates from the body-wall itself; *c*, terminal plate from the pedicels; *d*, supporting rods.

Fig. 6. *Cucumaria serrata*, var. *intermedia*, nov. (Station 151). Several developmental stages of plates.



G. Kolesnoff, del. Read & Cowie, Lith^rs Edin^r

1. ANKYRODERMA MARENZELLERI, n. sp. 2. TROCHOSTOMA ALBICANS, n. sp. 3. TROCHOSTOMA, sp. ???
4. GAUDINA CORIACEA, Ruston. 5. CUCUMARIA LÆVIGATA, Verrill. 6. CUCUMARIA SERRATA, var. INTERMEDIA, n.

PLATE IV.

PLATE IV.

Fig. 1. *Cucumaria serrata*, n. sp. *a*, plates from the body-wall itself; *b*, plates from the tentacles.

Fig. 2. *Cucumaria serrata*, var. *intermedia*, nov. (Station 150). *a*, plates from the body-wall itself; *b*, plates from the pedicels.

Fig. 3. *Cucumaria serrata*, var. *marionensis*, nov. Plates.

Fig. 4. *Cucumaria multipes*, n. sp. Different views of tables.

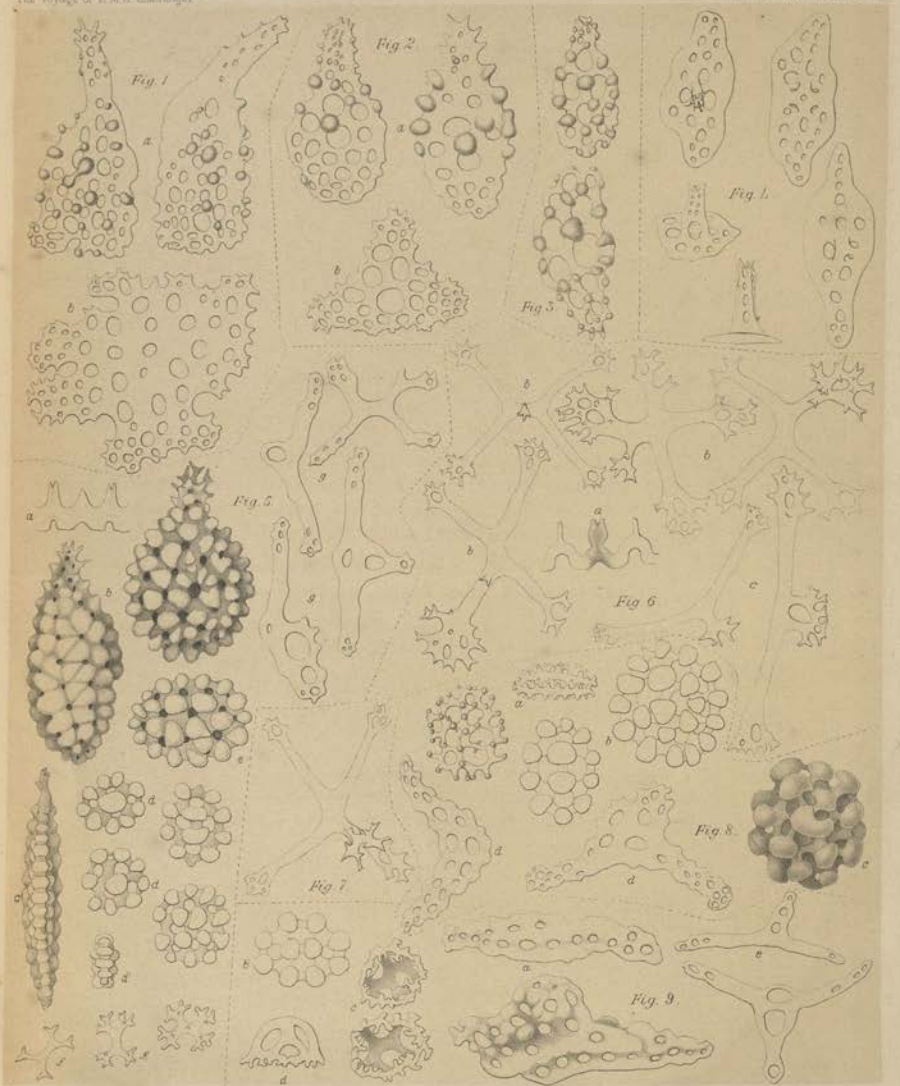
Fig. 5. *Cucumaria insolens*, n. sp. *a*, calcareous ring; *b*, large, elongate, knobbed plates or buttons, with one end prolonged and spinous; *c*, side view of the same plates; *d*, rounded buttons; *e*, transitional form between these two kinds of deposits; *f*, small cruciform bodies; *g*, supporting rods of the pedicels.

Fig. 6. *Cucumaria abyssorum*, n. sp. *a*, calcareous ring; *b*, different kinds of four-armed spicules from the body-wall itself; *c*, spicules from the pedicels.

Fig. 7. *Cucumaria abyssorum*, var. *hyalina*, nov. A four-armed spicule from the body-wall.

Fig. 8. *Cucumaria discolor*, n. sp. *a*, plates or cups from the exterior layer of the perisome; *b*, different kinds of knobbed buttons; *c*, scales; *d*, supporting plates from the ambulacral appendages.

Fig. 9. *Colochirus pygmæus*, n. sp. *a*, perforated plates from the body-wall itself; *b*, buttons; *c*, cups from the exterior layer of the perisome; *d*, side view of a cup, with the spinous, outwardly-directed rim turned downwards; *e*, supporting rods from the ambulacral appendages.



H.J. Theel, del. Reid & Cowie, Lith.

1, CUCUMARIA SERRATA, n.sp. 2, CUCUMARIA SERRATA, var. INTERMEDIA, n. 3. CUCUMARIA SERRATA, var. MARIONENSIS, n. 4. CUCUMARIA MULTIPES, n.sp. 5. CUCUMARIA INSOLENS, n. sp. 6. CUCUMARIA ABYSSORUM, n.sp. 7. CUCUMARIA ABYSSORUM, var. HYALINA, n. 8. CUCUMARIA DISCOLOR, n. sp. 9. COLOCHIRUS PYGMÆUS, n. sp.

PLATE V.

PLATE V.

Fig. 1. *Cucumaria abyssorum*, var. *grandis*, nov. Different kinds of deposits from the body-wall itself.

Fig. 2. *Cucumaria capensis*, n. sp. *a*, cups; *b*, knobbed buttons; *c*, scale-like, knobbed plates; *d*, supporting rods; *e*, calcareous ring.

Fig. 3. *Cucumaria mendax*, n. sp. *a*, plates; *b*, buttons; *c*, supporting rods or plates from the pedicels.

Fig. 4. *Colochirus violaceus*, n. sp. *a*, calcareous ring, six times the natural size; *b*, diverse forms of plates from the body-wall itself; *c*, supporting rods from the ambulacral appendages.

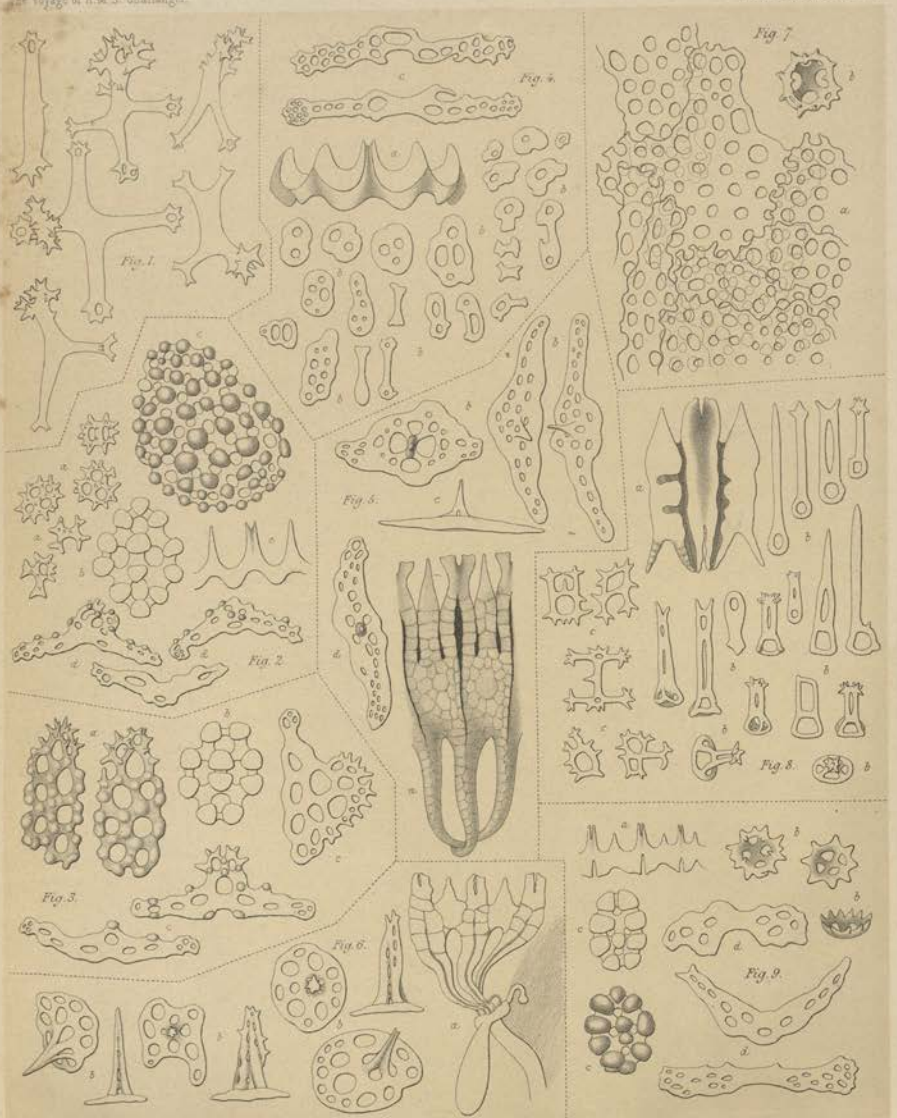
Fig. 5. *Thyonidium rugosum*, n. sp. *a*, calcareous ring, thrice the natural size; *b*, diverse forms of tables from the body-wall itself; *c*, side view of a table; *d*, supporting rods from the pedicels.

Fig. 6. *Orcula hypsipyrgus*, von Marenzeller. *a*, calcareous ring; *b*, diverse forms of tables.

Fig. 7. *Thyone recurvata*, n. sp. *a*, view of plates in natural position; *b*, cups.

Fig. 8. *Phyllophorus incompertus*, n. sp. *a*, calcareous ring; *b*, diverse forms of tables; *c*, deposits from the interior layer of the perisome.

Fig. 9. *Thyone pervicax*, n. sp. *a*, calcareous ring; *b*, cups; *c*, buttons; *d*, supporting rods from the pedicels.



1, CUCUMARIA ABYSSORUM, var. GRANDIS, n. 2, CUCUMARIA CAPENSIS, n. sp. 3, CUCUMARIA MENDAX, n. sp.
4, COLOCHIRUS VIOLACEUS, n. sp. 5, THYONIDIUM RUGOSUM, n. sp. 6, ORCULA HYPSIPYRGUS, von Marenzeller.
7, THYONE RECURVATA, n. sp. 8, PHYLLOPHORUS INCOMPERTUS, n. sp. 9, THYONE PERVICAX, n. sp.

PLATE VI.

PLATE VI.

Fig. 1. *Psolus antarcticus*, Philippi. Deposits from the sole.

Fig. 2. *Psolus squamatus*, Düben and Koren, var. Deposits from the sole.

Fig. 3. *Psolus ephippifer*, Wyv. Thomson. *a*, transverse section of the saddle-like elevation of the dorsal perisome, showing the cloister-like space between the columns; *b*, deposits from the sole; *c*, calcareous ring.

Fig. 4. *Psolus murrayi*, n. sp. *a*, plates from the sole; *b*, cups from the sole.

Fig. 5. *Psolus incertus*, n. sp. *a*, a scale with pores, *x*; *b*, deposits from the sole.

Fig. 6. *Colochirus australis*, Ludwig. *a*, buttons; *b*, a cup; *c*, supporting rods from the pedicels; *d*, piece of the skin with two pedicels.

Fig. 7. *Colochirus quadrangularis*, Lesson. *a*, a spherical, reticulate body; *b*, diverse views of cups; *c*, supporting rod from the pedicels; *d*, flat cups from the pedicels.

Fig. 8. *Colochirus inornatus*, von Marenzeller. *a*, diverse forms of cups from the exterior layer of the perisome; *b*, button.

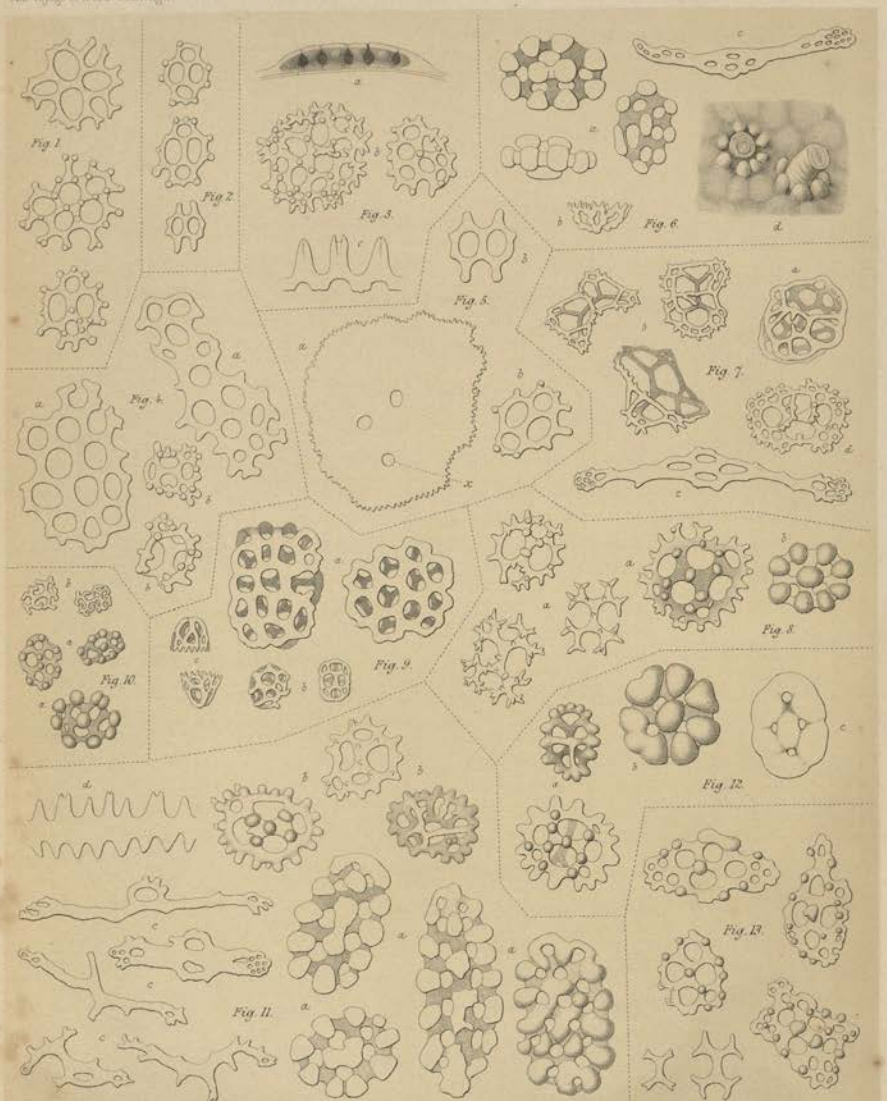
Fig. 9. *Colochirus cucumis*, Semper. *a*, large reticulate spheres; *b*, small reticulate spheres; *c*, cups or hemispheres.

Fig. 10. *Ocnus typicus*, n. sp. *a*, knobbed buttons; *b*, dichotomously branched bodies or rosettes.

Fig. 11. *Colochirus challengeri*, n. sp. *a*, diverse forms of buttons; *b*, upper and under views of cups; *c*, supporting rods of the dorsal pedicels; *d*, calcareous ring, twice the natural size.

Fig. 12. *Colochirus spinosus*, Quoy and Gaimard. *a*, cups; *b* and *c*, buttons.

Fig. 13. *Cucumaria lævigata*, Verrill (from Betsy Cove). Plates from the body-wall itself.



H. Théel del.

F. Huth, Lith^r Edin^r

1, PSOLUS ANTARCTICUS, Philippi. 2, PSOLUS SQUAMATUS, Düben & Koren, var. 3, PSOLUS EPHIPPIFER, W. Thompson.
4, PSOLUS MURRAYI, n. sp. 5, PSOLUS INCERTUS, n. sp. 6, COLOCHIRUS AUSTRALIS, Ludwig. 7, COLOCHIRUS QUADRANGULARIS, Lesson.
8, COLOCHIRUS INORNATUS, von Marenzeller. 9, COLOCHIRUS CUCUMIS, Semper. 10, OCNUS TYPICUS, n. sp.
11, COLOCHIRUS CHALLENGERI, n. sp. 12, COLOCHIRUS SPINOSUS, Quoy & Gaimard. 13, CUCUMARIA LÆVIGATA, Verrill.

PLATE VII.

PLATE VII.

Fig. 1. *Thyone fusus*, var. *papuensis*, nov. *a*, calcareous ring, five times the natural size; *b*, tables from the body-wall itself; *c*, supporting rods from the pedicels.

Fig. 2. *Holothuria fusco-rubra*, n. sp. *a*, tables devoid of spire; *b*, buttons; *c*, plates from the pedicels; *d*, calcareous ring, twice the natural size.

Fig. 3. *Stichopus japonicus*, Selenka. *a* and *b*, tables; *c*, disks of tables and buttons; *d*, supporting rods of the pedicels; *e*, supporting rods of the papillæ.

Fig. 4. *Holothuria atra*, Jæger. *a* and *b*, different views of tables; *c*, plates and rosettes.

Fig. 5. *Stichopus haytiensis*, Semper (?). *a*, disks of the tables, seen from the under surface; *b*, ends of the spire of the tables; *c*, side view of a table; *d*, incomplete table from the pedicels; *e*, calcareous ring, twice the natural size; *f*, a C-shaped body.

Fig. 6. *Stichopus chloronotus*, Brandt. *a*, disks of the tables, seen from the under surface; *b*, ends of the spire of the tables, seen from above; *c*, side view of a table; *d*, a rosette-shaped or dichotomously branched body; *e*, C-shaped bodies; *f*, calcareous ring, about three times the natural size; *g*, rods from the pedicels.

Fig. 7. *Stichopus variegatus*, Semper. *a*, disks of the tables, seen from the under surface; *b*, end of the spire of a table, seen from above; *c*, side view of a table; *d*, rosette-shaped or dichotomously branched bodies; *e*, C-shaped bodies; *f*, rods from the pedicels.

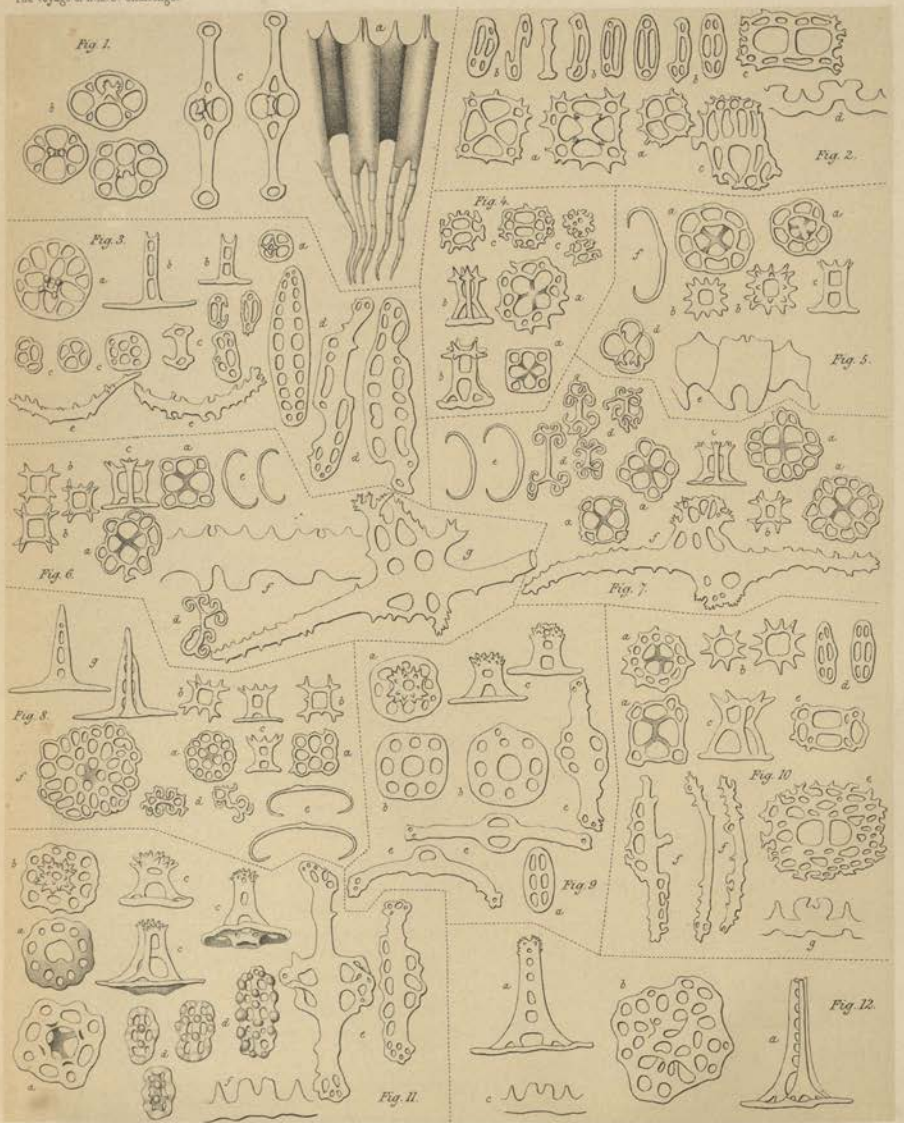
Fig. 8. *Stichopus godeffroyi*, var. *b*, Semper. *a*, disks of the tables; *b*, ends of the spire, seen from above; *c*, side views of tables; *d*, rosettes; *e*, C-shaped bodies; *f*, disk of a large table with the spire conical, terminating in a single top; *g*, side views of large tables with conical spire.

Fig. 9. *Holothuria impatiens*, Forskaal. *a*, a table seen from above; *b*, disks of tables seen from the under surface; *c*, side views of tables; *d*, button; *e*, supporting rods from the ambulacral appendages.

Fig. 10. *Holothuria vagabunda*, Selenka. *a*, disks of tables; *b*, ends of the spires of the tables; *c*, side view of a table; *d*, buttons; *e*, supporting plates from the ventral pedicels; *f*, supporting rods from the papillæ; *g*, calcareous ring.

Fig. 11. *Holothuria ocellata*, Jæger. *a*, disks of the tables, seen from the under surface; *b*, table seen from above; *c*, side views of tables; *d*, buttons; *e*, supporting rods from the papillæ; *f*, calcareous ring, about twice the natural size.

Fig. 12. *Holothuria martensii*, Semper. *a*, side views of tables; *b*, disk of the tables, seen from the under surface; *c*, calcareous ring, twice the natural size.



H. Théel, del.

F. Huth, Lith^r Edin^r

1, THYONE FUSUS, var. PAPUENSIS, n. 2, HOLOTHURIA FUSCO-RUBRA, n. sp. 3, STICHOPUS JAPONICUS, Selenka.
4, HOLOTHURIA ATRA, Jæger. 5, STICHOPUS HAYTIENSIS, Semper(?) 6, STICHOPUS CHLORONOTUS, Brandt.
7, STICHOPUS VARIEGATUS, Semper. 8, STICHOPUS GODEFFROYI, var. b. Semper. 9, HOLOTHURIA IMPATIENS, Forskaal.
10, HOLOTHURIA VAGABUNDA, Selenka. 11, HOLOTHURIA OCELLATA, Jæger. 12, HOLOTHURIA MARTENSII, Semper.

PLATE VIII.

PLATE VIII.

Fig. 1. *Holothuria spinifera*, n. sp. *a*, side view of a table; *b*, disk of a table, seen from the under surface; *c*, side view of a large table, belonging to the papillæ; *d*, disk of the same table, seen from the under surface; *e*, buttons, seen from above; *f*, side views of buttons; *g*, supporting rods from the ambulacral appendages.

Fig. 2. *Stichopus japonicus*, var. *typicus*, nov. *a*, disk of a table, seen from the under surface; *b* and *c*, side views of tables; *d*, diverse forms of tables with the spire more or less reduced; *e*, supporting rods from the dorsal processes; *f*, dorsal view of the calcareous ring; *g*, ventral view of the calcareous ring.

Fig. 3. *Stichopus sordidus*, n. sp. *a*, spire of a table, seen from above; *b*, side view of a table; *c*, disks of the tables, seen from the under surface; *d*, fenestrated plate from the pedicels.

Fig. 4. *Psolus incertus*, n. sp. Side view, twice the natural size.

Fig. 5. *Phyllophorus incompertus*, n. sp. Anterior extremity of the body.

Fig. 6. *Thyone recurvata*, n. sp. Side view, natural size.

Fig. 7. *Holothuria africana*, n. sp. *a*, spire of the tables, seen from above; *b*, side view of a table; *c*, disks of the tables, seen from the under surface; *d*, irregularly rectangular plates; *e*, rounded plates.

Fig. 8. *Holothuria minax*, n. sp. *a*, upper view of a table; *b*, disks of the tables, seen from the under surface; *c*, buttons; *d*, supporting rods from the pedicels.

Fig. 9. *Holothuria curiosa*, Ludwig. *a*, diverse forms of tables; *b*, buttons; *c*, elongate buttons from the pedicels; *d*, supporting rods or plates from the pedicels.

Fig. 10. *Holothuria monacaria*, Lesson. *a*, upper view of a table; *b*, under views of tables; *c*, side view of a table; *d*, buttons; *e*, supporting rods from the pedicels; *f* and *g*, rods from the dorsal appendages.

H. Theel del.

F. Huth, Lith. Edin.

1, HOLOTHURIA SPINIFERA, n. sp. 2, STICHOPUS JAPONICUS var. TYPICUS, n. 3, STICHOPUS SORDIDUS, n. sp.
4, PSOLUS INCERTUS, n. sp. 5, PHYLLOPHORUS INCOMPERTUS, n. sp. 6, THYONE RECURVATA, n. sp. 7, HOLOTHURIA AFRICANA, n. sp.
8, HOLOTHURIA MINAX, n. sp. 9, HOLOTHURIA CURIOSA, Ludwig. 10, HOLOTHURIA MONACARIA, Lesson.

PLATE IX.

PLATE IX.

Fig. 1. *Stichopus möbii*, Semper. *a* and *b*, under view and side view of the common tables; *c*, end of the spire of the same tables, seen from above; *d*, side views of larger tables; *e*, under views of larger tables; *f*, supporting rods from the pedicels; *g*, C-shaped body.

Fig. 2. *Holothuria murrayi*, var. *parva*, nov. *a*, disk of the common form of tables, seen from the under surface; *b*, disk of the rare tables, seen from the under surface; *c*, side view of a table; *d*, end of the spire of the tables.

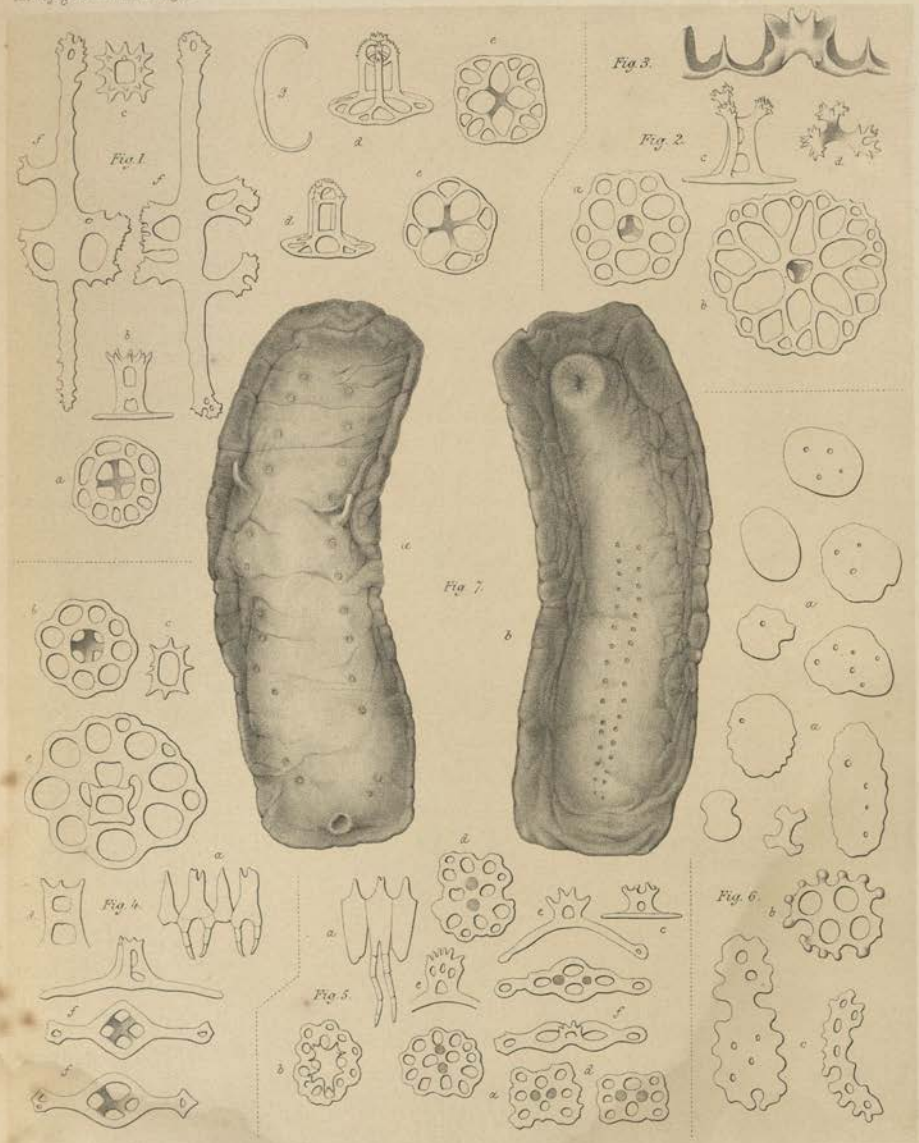
Fig. 3. *Holothuria murrayi*, n. sp. (var.?). Calcareous ring, three times the natural size.

Fig. 4. *Thyonidium cebuense*, Semper. *a*, calcareous ring, about seven times the natural size; *b*, *c*, *d*, diverse views of small tables; *e*, a large table seen from above; *f*, rod-like tables from the pedicels.

Fig. 5. *Cucumaria mirabilis*, n. sp. *a*, calcareous ring, about twenty times the natural size; *b*, *c*, *d*, diverse views of tables; *e*, *f*, diverse views of supporting rods from the ambulacral appendages.

Fig. 6. *Psolus disciformis*, n. sp. *a*, *b*, plates from the sole; *c*, rods from the pedicels.

Fig. 7. *Pælopatides confundens*, n. sp. *a*, dorsal view; *b*, ventral view, natural size.



1, STICHOPUS MOEBII, Semper. 2, HOLOTHURIA MURRAYI var. PARVA, n. 3, HOLOTHURIA MURRAYI, n. sp. (var.)
4, THYONIDIUM CEBUENSE, Semper. 5, CUCUMARIA MIRABILIS, n. sp. 6, PSOLUS DISCIFORMIS, n. sp.
7. PÆLOPATIDES CONFUNDENS, n. sp.

PLATE X.

PLATE X.

Fig. 1. *Pælopatides confundens*, n. sp. (Station 299). Spicules from the dorsal papillæ.

Fig. 2. *Stichopus torvus*, n. sp. Calcareous ring, thrice the natural size.

Fig. 3. *Stichopus torvus*, n. sp. Branched processes from the sides of the body.

Fig. 4. *Stichopus torvus*, n. sp. A portion of the genital bundles, natural size.

Fig. 5. *Pseudostichopus mollis*, n. sp. Posterior extremity of the body, natural size. *a*, anal furrow.

Fig. 6. *Pseudostichopus mollis*, n. sp. Calcareous ring, four times the natural size.

Fig. 6*b*. *Pseudostichopus villosus*, var. *violaceus*, nov. Calcareous ring, almost natural size.

Fig. 7. *Pælopatides confundens*, n. sp. (Station 300). Three-armed spicule.

Fig. 8. *Holothuria thomsoni*, n. sp. (Station 244). Tables, seen from above.

Fig. 9. *Holothuria lactea*, n. sp. (Station 78). Table, seen from above.

Fig. 10. Holothurid, from Station 271. Four-armed spicule with a central spinous column.

Fig. 11. *Holothuria thomsoni*, n. sp. (Station 237). *a*, upper view of a table; *b*, side view of a table; *c*, a spicule from the pedicels; *d*, *e*, tables from the pedicels, seen from the under surface.

Fig. 12. Holothurid, from Station 89. Two forms of spicules.

Fig. 13. *Pælopatides aspera*, n. sp. Upper view of a spinous four-armed spicule.

Fig. 14. Holothurid, from Station 298. Calcareous ring, twice the natural size.

Fig. 15*a*. *Holothuria lactea*, n. sp. Calcareous ring.

Fig. 15*b*. *Holothuria lactea*, n. sp. (Station 169). Side view of a table.

Fig. 16. *Holothuria murrayi*, n. sp. Calcareous ring, twice the natural size.

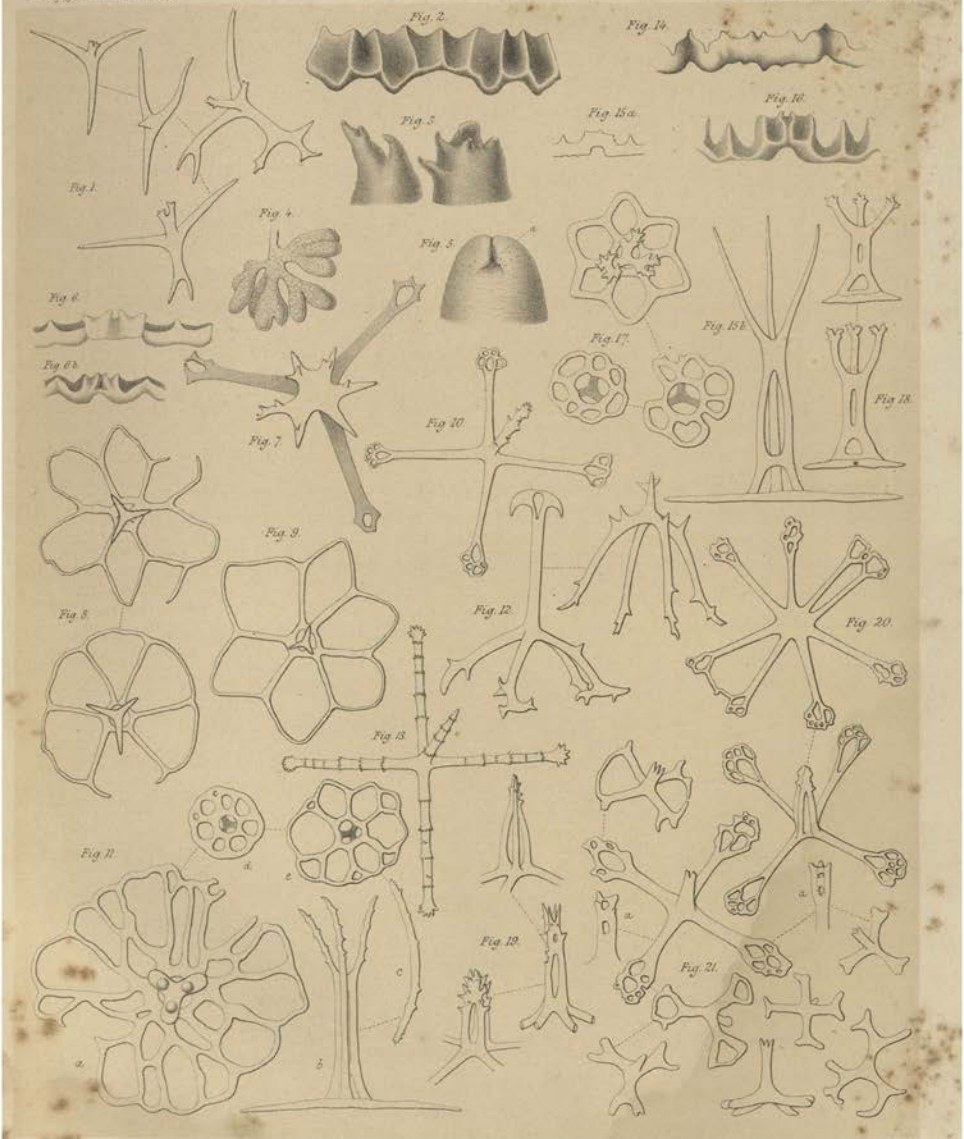
Fig. 17. *Holothuria murrayi*, n. sp. Upper and under views of tables.

Fig. 18. *Holothuria murrayi*, n. sp. Side views of tables.

Fig. 19. *Stichopus moseleyi*, n. sp. Side views of the spire of the tables.

Fig. 20. *Stichopus moseleyi*, n. sp. Upper and under views of tables.

Fig. 21. *Stichopus challengeri*, n. sp. Diverse views of tables. *a*, ends of the spires.



1, PÆLOPATIDES CONFUNDENS n.sp 2-4, STICHOPUS TORVUS, n.sp. 5-6, PSEUDOSTICHOPUS MOLLIS, n.sp. 6b, PSEUDOSTICHOPUS VILLOSUS, var VIOLACEUS, n. 7, PÆLOPATIDES CONFUNDENS, n.sp. 8, HOLOTHURIA THOMSONI, n.sp. 9, HOLOTHURIA LACTEA, n.sp. 10, HOLOTHURID from St. 271. 11, HOLOTHURIA THOMSONI, n.sp. 12, HOLOTHURID from St. 89. 13, PÆLOPATIDES ASPERA, n.sp. 14, HOLOTHURID from St. 298. 15, HOLOTHURIA LACTEA, n.sp. 16-18, HOLOTHURIA MURRAYI, n.sp. 19-20, STICHOPUS MOSELEYI, n.sp. 21, STICHOPUS CHALLENGERI, n.sp.

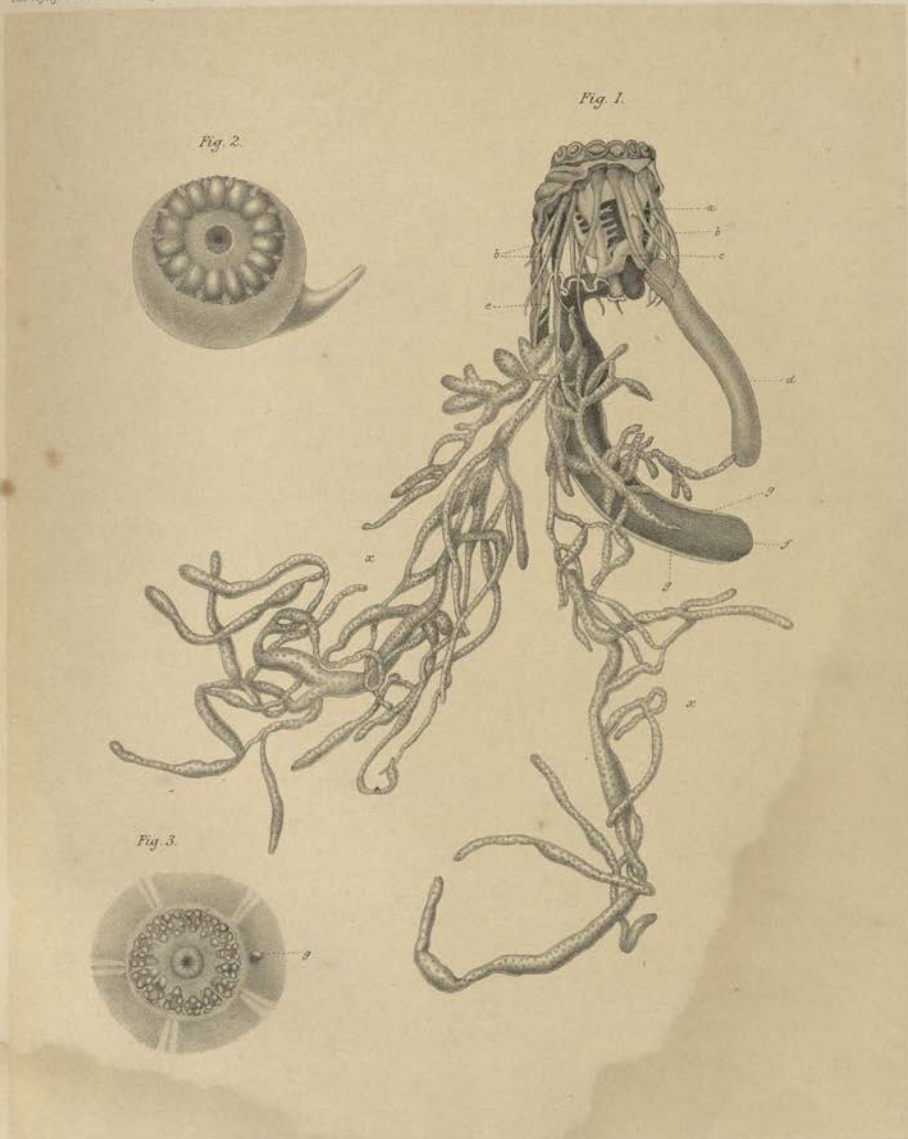
PLATE XI.

PLATE XI.

Fig. 1. *Trochostoma violaceum*, Studer. View of the internal organisation from the anterior portion of the body. *a*, calcareous ring; *b*, tentacular ampullæ; *c*, water-vascular ring; *d*, Polian vesicle; *e*, madreporic canal; *f*, intestine; *g*, vessels; *x*, genital organs.

Fig. 2. *Ankyroderma simile*, n. sp. Seen from the anterior extremity of the body.

Fig. 3. *Trochostoma albicans*, n. sp. Anterior portion of the body with mouth and tentacles; *g*, genital papilla.



G. Kolthoff del.

F. Huth, Lith^r Edin^r

1, TROCHOSTOMA VIOLACEA, Studer. 2, ANKYRODERMA SIMILE, n. sp. 3, TROCHOSTOMA ALBICANS, n. sp.

PLATE XII.

PLATE XII.

Fig. 1. *Cucumaria crocea*, Lesson. Ventral view, natural size

Fig. 2. *Cucumaria crocea*, Lesson. Dorsal view, natural size.

Fig. 3. *Thyone pervicax*, n. sp. Dorsal view, six times the natural size.

Fig. 4. *Actinocucumis typica*, Ludwig. Ventral view, natural size.

Fig. 5. *Actinocucumis typica*, Ludwig. Dorsal view, natural size.

Fig. 6. *Cucumaria kerguelensis*, n. sp. Ventral view, natural size.

Fig. 7. *Cucumaria kerguelensis*, n. sp. Dorsal view, natural size.

Fig. 1.

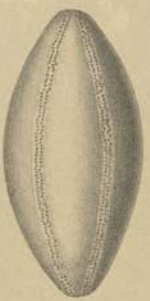


Fig. 2.

Fig. 3.

Fig. 4.

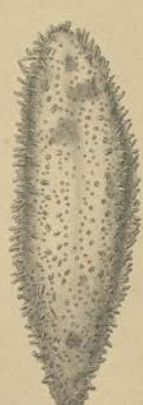


Fig. 5.

Fig. 6.

Fig. 7.

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1-2 CUCUMARIA CROCEA, Lesson. 3, THYONE PERVICAX, n. sp. 4-5, ACTINOCUCUMIS TYPICA, Ludwig.
6-7, CUCUMARIA KERGUELENSIS, n. sp.

PLATE XIII.

PLATE XIII.

Fig. 1. *Colochirus violaceus*, n. sp. Ventral view, natural size.

Fig. 2. *Colochirus violaceus*, n. sp. Dorsal view, natural size. The skin is cut up so that some of the internal organs become visible. *m*, mouth; *a*, anus; *t*, anal teeth.

Fig. 1.

Fig. 2.

G. Kolthoff del.

T. Roth, Lith. Edin.

COLOCHIRUS VIOLACEUS, n. sp.

PLATE XIV.

PLATE XIV.

Fig. 1. *Colochirus challengeri*, n. sp. Dorsal view, natural size. *a*, anus.

Fig. 2. *Colochirus challengeri*, n. sp. Ventral view, natural size.

Fig. 3. *Colochirus spinosus*, Quoy and Gaimard. Dorsal view, natural size. *a*, anus.

Fig. 4. *Colochirus spinosus*, Quoy and Gaimard. Side view, natural size.

Fig. 5. *Colochirus australis*, Ludwig. Dorsal view, natural size.

Fig. 6. *Colochirus australis*, Ludwig. Ventral view, natural size.

Fig. 7. *Colochirus quadrangularis*, Lesson. Dorsal view, natural size. *a*, anus.

Fig. 8. *Colochirus quadrangularis*, Lesson. Ventral view, natural size.

Fig. 9. *Colochirus cucumis*, Semper. Dorsal view, natural size. *a*, anus.

Fig. 10. *Colochirus cucumis*, Semper. Ventral view, natural size.

Fig. 11. *Ocnus typicus*, n. sp. Side view, about twice the natural size.

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1-2, COLOCHIRUS CHALLENGERI, n. sp. 3-4, COLOCHIRUS SPINOSUS, Quoy & Gaimard. 5-6, COLOCHIRUS AUSTRALIS, Ludwig. 7-8, COLOCHIRUS QUADRANGULARIS, Lesson. 9-10, COLOCHIRUS CUCUMIS, Semper. 11, OCNUS TYPICUS, n. sp.

PLATE XV.

PLATE XV.

Fig. 1. *Psolus squamatus*, Düben and Koren (var.?) (Station 307). Dorsal view, natural size. *m*, mouth; *a*, anus.

Fig. 2. *Psolus squamatus*, Düben and Koren (var.?) (Station 307). Ventral view, natural size.

Fig. 3. *Psolus antarcticus*, Philippi (Station 308). Dorsal view, natural size. *m*, mouth; *a*, anus.

Fig. 4. *Psolus antarcticus*, Philippi (Station 308). Ventral view, natural size.

Fig. 5. *Psolus murrayi*, n. sp. Dorsal view, three times the natural size. *m*, mouth; *a*, anus.

Fig. 6. *Psolus murrayi*, n. sp. Ventral view, three times the natural size.

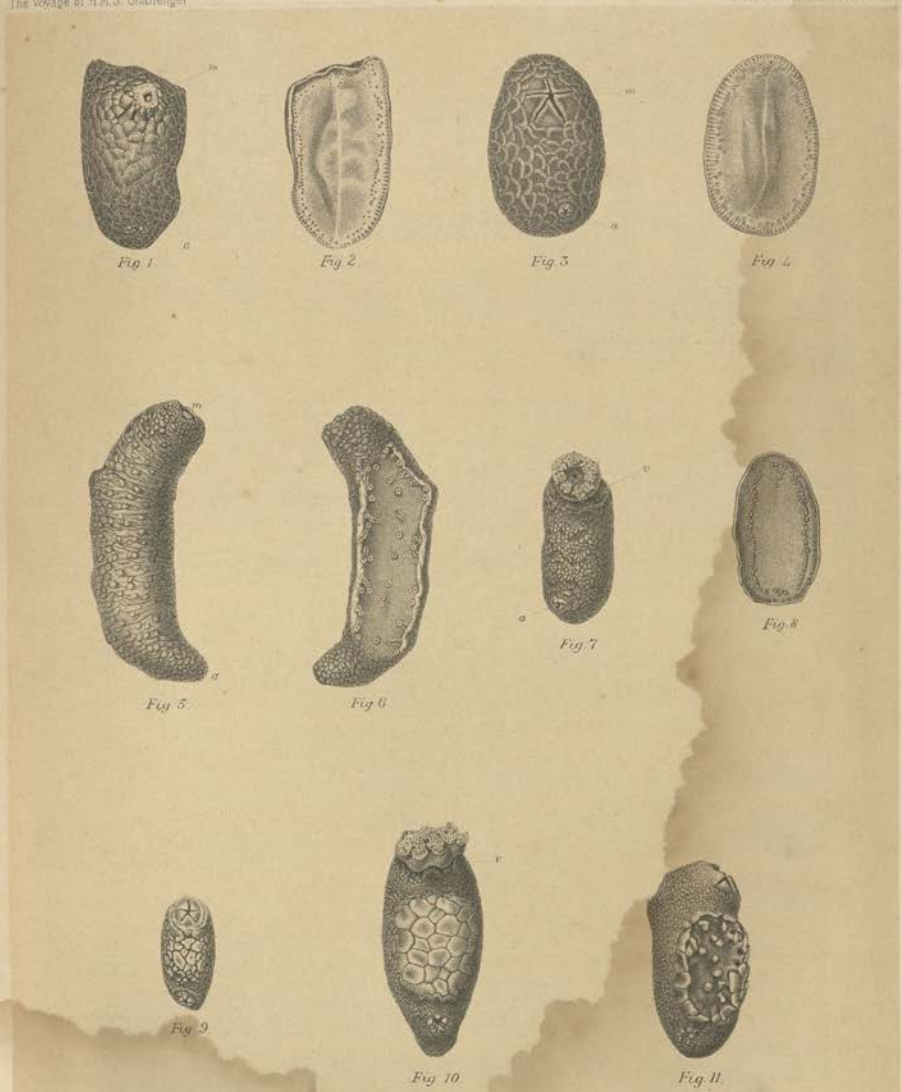
Fig. 7. *Psolus ephippifer*, Wyv. Thomson. Dorsal view of a male, slightly magnified. *a*, anus; *v*, oral valves.

Fig. 8. *Psolus ephippifer*, Wyv. Thomson. Ventral view of a male.

Fig. 9. *Psolus ephippifer*, Wyv. Thomson. Dorsal view of a young immature female, natural size.

Fig. 10. *Psolus ephippifer*, Wyv. Thomson. Dorsal view of a mature female, slightly magnified. *v*, oral valves.

Fig. 11. *Psolus ephippifer*, Wyv. Thomson. Dorsal view of a mature female, slightly magnified, most of the exterior disks of the card-table shaped scales having been removed.



G. Kolthoff, del.

Reid & Coote Lith^rs Edin^r

1-2. PSOLUS SQUAMATUS, Düben & Koren. (var ?). 3-4. PSOLUS ANTARCTICUS, Philippi. 5-6. PSOLUS MURRAYI, n. sp.
7-11. PSOLUS EPHIPPIFER, Wyville Thomson.

PLATE XVI.

PLATE XVI.

Fig. 1. *Holothuria ocellata*, Jæger. Dorsal view, natural size.

Fig. 2. *Holothuria martensii*, Semper. Dorsal view, natural size.

Fig. 3. *Cucumaria mendax*, n. sp. (Station 315). Natural size.

Fig. 4. *Holothuria murrayi*, var. *parva* nov. (Station 219). Ventral view, natural size.

Fig. 5. *Holothuria murrayi*, var. *parva* nov. (Station 219). Dorsal view, natural size.

Fig. 6. *Cucumaria abyssorum*, n. sp. (Station 156). Natural size.

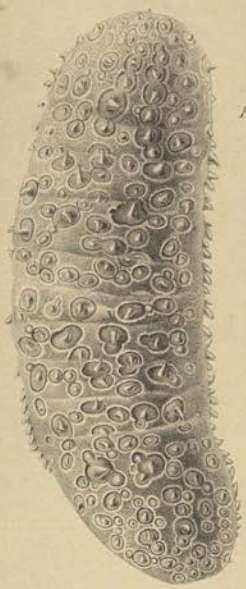


Fig. 1.

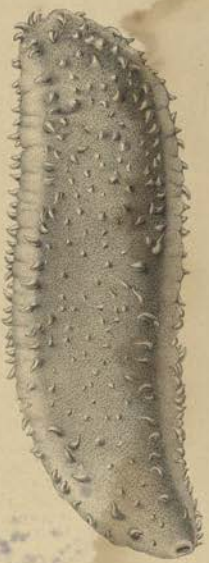


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Romin & Théel del.

P. Bush, Lith. Edin.

1, HOLOTHURIA OCELLATA, Jæger. 2, HOLOTHURIA MARTENSII, Semper. 3, CUCUMARIA MENDAX n. sp.
4-5 HOLOTHURIA MURRAYI var. PARVA, n. 6, CUCUMARIA ABYSSORUM n. sp.

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